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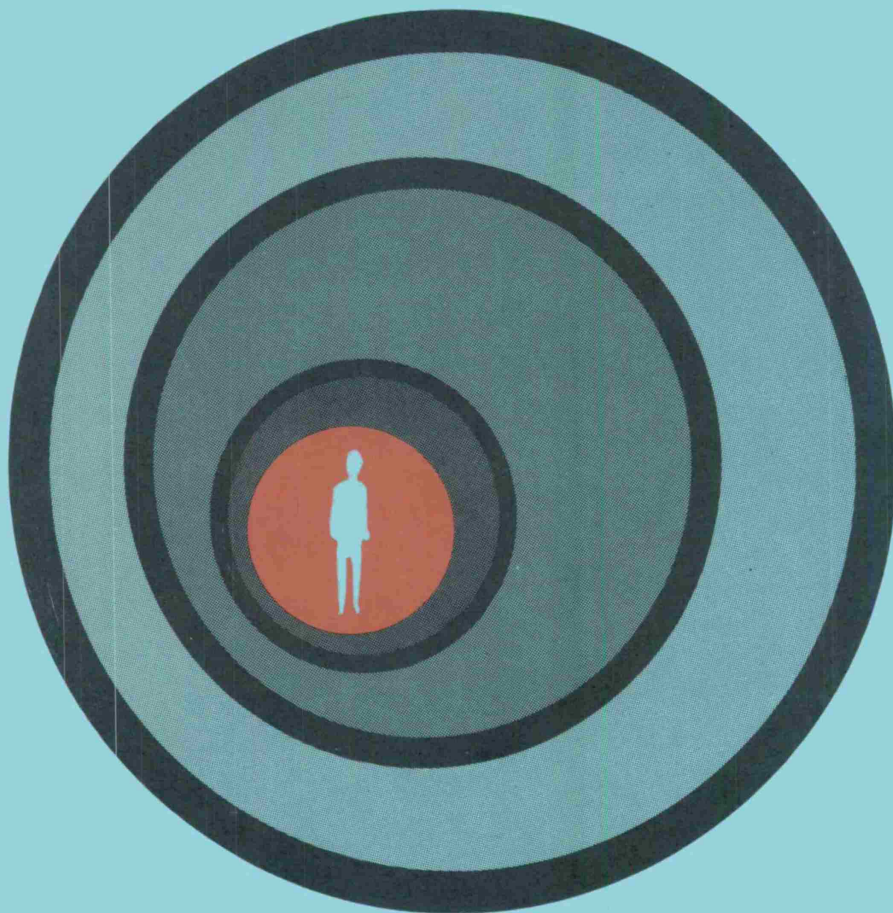
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TAEG REPORT
NO. 11-2

APPLICATION OF SIMULATION TO
INDIVIDUALIZED SELF-PACED TRAINING

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SEPTEMBER 1974



TRAINING ANALYSIS AND EVALUATION GROUP
ORLANDO, FLORIDA 32813

Application of Simulation to Individualized
Self-Paced Training

ABSTRACT

Computer simulation is recognized as a valuable systems analysis research tool which enables the detailed examination, evaluation, and manipulation, under stated conditions, of a system without direct action on the system. This technique provides management with quantitative data on system performance and capabilities which can be used to compare proposed methods, concepts, or designs. The planning of a new Navy technical school provided the opportunity to demonstrate the feasibility and value of simulation as applied to training systems. The school was being programmed to use individualized self-paced instruction and, therefore, was considered to be representative of future instructional systems in the Navy. Not only would the replication of the system prove the feasibility of the application of simulation, but it would provide the training planners with the capability of assessing their particular conceptual system and of checking the validity of their assumptions.

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Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Training Analysis and Evaluation Group Orlando, FL 32813		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE Application of Simulation to Individualized Self-Paced Training			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report			
5. AUTHOR(S) (First name, middle initial, last name) William H. Lindahl and James H. Gardner			
6. REPORT DATE September 1974		7a. TOTAL NO. OF PAGES 78	7b. NO. OF REFS 9
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S) TAEG Report No. 11-2	
b. PROJECT NO.			
c. Work Assignment No. 1062		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT Approved for public release; distribution is unlimited			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
13. ABSTRACT Computer simulation is recognized as a valuable systems analysis research tool which enables the detailed examination, evaluation, and manipulation, under stated conditions, of a system without direct action on the system. This technique provides management with quantitative data on system performance and capabilities which can be used to compare proposed methods, concepts, or designs. The planning of a new Navy technical school provided the opportunity to demonstrate the feasibility and value of simulation as applied to training systems. The school was being programmed to use individualized self-paced instruction and, therefore, was considered to be representative of future instructional systems in the Navy. Not only would the replication of the system prove the feasibility of the application of simulation, but it would provide the training planners with the capability of assessing their particular conceptual system and of checking the validity of their assumptions.			

DD FORM 1473

1 NOV 65

(PAGE 1)

S/N 0102-014-6600

Unclassified

Security Classification

KEY WORDS

Computer Simulation
Systems Analysis
Training Systems Simulation
Instructional Systems
Individualized Self-paced Training

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TAEG REPORT NO. 11-2

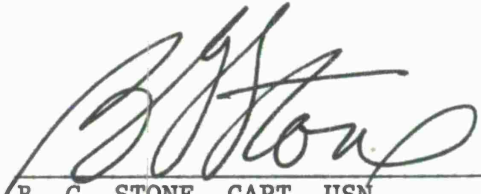
APPLICATION OF SIMULATION TO INDIVIDUALIZED
SELF-PACED TRAINING

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SEPTEMBER 1974


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FOREWORD

This report is the second in a series concerned with the Training Analysis and Evaluation Group's (TAEG's) effort undertaken in partial fulfillment of the requirements of the Technical Development Plan (TDP) P43-03X, Part 01A, "Design of Training Systems."

A summary of the application of simulation to a training system is presented. The purpose of the report is to describe the goals of this effort and to outline the problem, approach, and results to date.

The report was prepared by Mr. J. Gardner, Operations Research Analyst, Naval Training Equipment Center (NAVTRAEQUIPCEN) and Mr. W. Lindahl, Operations Research Analyst, Training Analysis and Evaluation Group, Orlando, Florida.

Appreciation is expressed to the members of the TAEG Electronic Warfare Project Team who provided guidance in the conceptualization of the training system and to Mr. L. Erhlich and Mr. R. Yanko, both of the IBM Corporation, for their assistance with the GPSS programming effort.

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
I	INTRODUCTION.	1
	Purpose	1
	Background.	1
II	METHOD.	5
	Define and Constrain the System	6
	Develop a Program and Execute	8
	Manipulate Variables and Analyze Outputs.	12
III	RESULTS	17
IV	CONCLUSIONS	23
V	RECOMMENDATIONS	25
	BIBLIOGRAPHY.	27
	APPENDIX A.	29
	APPENDIX B.	43
	APPENDIX C.	67

TAEG REPORT NO. 11-2

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Completion Times for an Input Rate of Four Students Per Day.	18
2	Average Completion Times	22
3	Expected Annual EW Operator Training System Output . .	22

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	Individual Tracks Through Common Modules	3
2	Time-Shared Dimension of Training Media.	4
3	Proposed Student/Learning Module Matrix for EW Operator Training	7
4	Student Characteristics.	9
5	Cumulative Exponential or Poisson Distribution Function to Describe Student Arrivals.	10
6	Student Mix.	11
7	Macro Model Flow	13
8	Input/Output/Constraint Diagram.	14

SECTION I

INTRODUCTION

PURPOSE

This study was performed under the aegis of the Technical Development Plan (TDP) P43-03X, Part 01A, "Design of Training Systems." The purpose of the study was to examine the feasibility of the application of computer simulation to an individualized self-paced training system. Computer simulation is recognized as a valuable systems analysis research tool which enables the detailed examination, evaluation, and manipulation, under stated conditions, of a system without direct action on the system. Since the optimal assignment of personnel and the maximum usage of equipment resources in training are of paramount importance to the Navy, the demonstration of the feasibility of the application of simulation to the solution of scheduling problems is a contribution to the systematic management of instruction. While use of simulation is not unique in the area of system analysis, the application of simulation to a training system is unique. No documented simulation of a training system with individualized self-paced training could be found.

BACKGROUND

The Design of Training Systems (DOTS) Project Team determined that an in-house effort to demonstrate the feasibility and usefulness of simulation to managers concerned with training was needed. The concurrent planning by another Training Analysis and Evaluation Group (TAEG) team for a new Electronic Warfare (EW) School provided the vehicle for the demonstration of a simulation technique. Since the EW School was being programmed to employ the latest techniques in training and education, it was considered an appropriate area of concentration. The simulation product(s) could then be generalized and applied to other specific applications by minor modifications.

The area chosen to demonstrate simulation capabilities was the instruction to be provided to the EW operator personnel at Corry Station, Pensacola, Florida.

The problem confronting the EW School planners is to provide individualized, self-paced instruction with the resources available and with a required output. In an individualized, self-paced instructional system, each student type proceeds through a prescribed course of instruction at his own pace. The prescribed course of instruction is composed of discrete instructional elements, or learning modules. The individual nature of the learning module prescriptions dictates that all students do not take all learning modules but travel through a track of modules tailored to their specific instructional needs. Figure 1 depicts the notion of individual tracks through common modules.

The problem of scheduling, planning, controlling, and forecasting for a system composed of learning modules is not merely a function of the students' learning rates in each module. Each module requires some form of training support media; e.g., programmed instruction, procedures trainers, or sound/slide (Figure 2).

The manager's problem is one of attempting to reduce student waiting times associated with learning modules by providing adequate numbers of modules and corresponding media for the modules. Given a required student output by type and number, the manager must determine the required input, the scheduling of the input, and the quantity and types of training media required to preclude bottlenecks in throughput rates, in order to meet the output requirements.

LEARNING MODULE

INPUT		TRAINED MAN OUTPUT						
CANDIDATE		1	2	3	4	5	6	7
A	→	→		→	→		→	→
B	→		→	→	→			→
C	→	→			→		→	→
D	→	→		→	→		→	→
E	→		→	→				→

Figure 1. Individual Tracks Through Common Modules

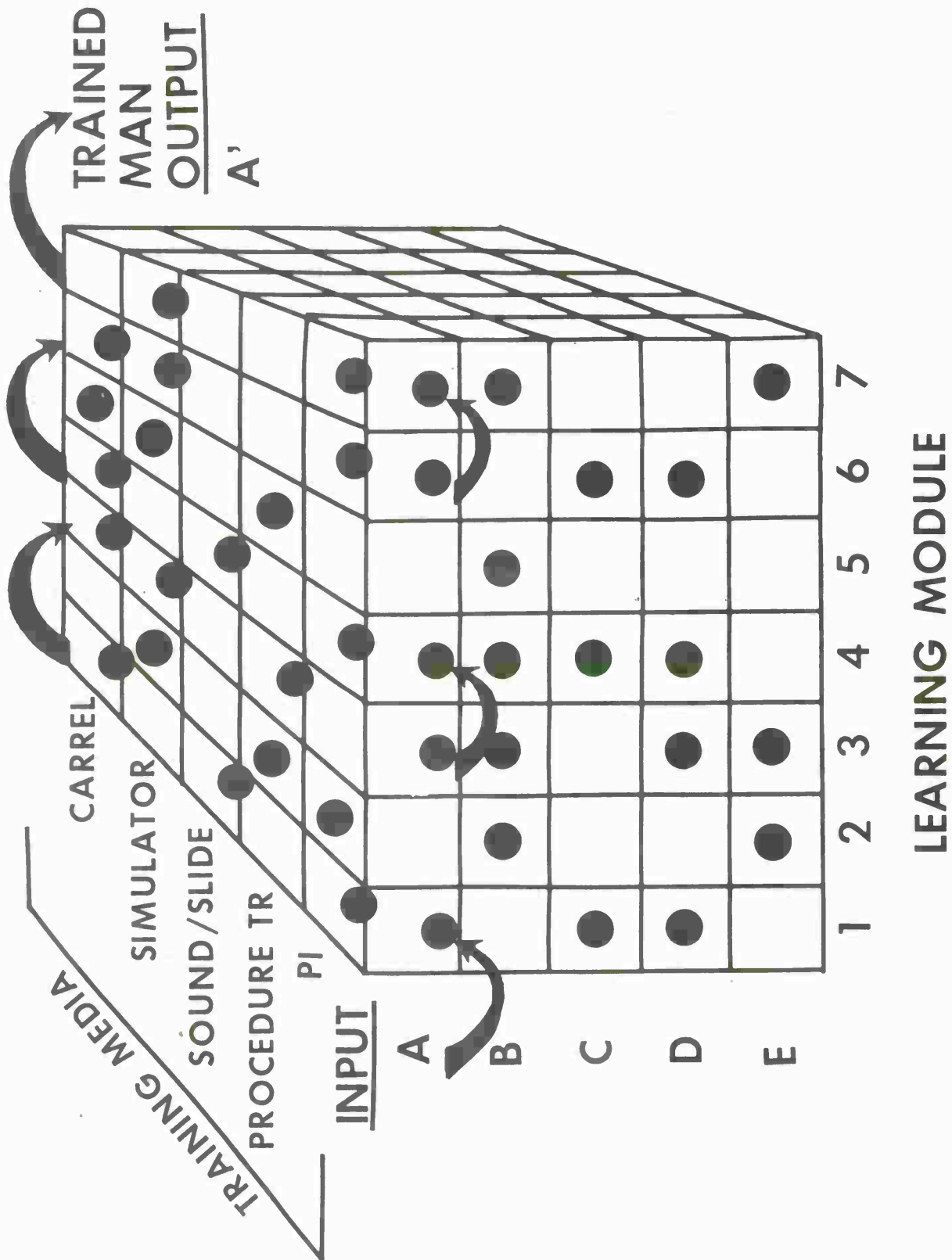


Figure 2. Time-shared Dimension of Training Media

SECTION II

METHOD

The feasibility study of applying simulation to EW operator training systems was structured to include the following: the selection of a representative training system, the selection of a simulation language, the development of a computer program to simulate the system, the manipulation of the simulated system to ask "what if" questions, the analysis of the output data, and a report documenting the study and recommendations. The EW Operator Training System was selected as an appropriate "test-bed" as it was considered to be representative of the approach to instruction to be employed in the Navy training system of the 1980's. In addition, the relative convenience with which system-specific data could be obtained from the TAEG's EW team made this selection doubly desirable.

The computer language selected for the simulation programming was General Purpose Simulation System (GPSS), developed by the IBM Corporation. This high-order computer language handles discrete-event models as network flow models. The selection of this language was due primarily to the possession of in-house programming capabilities utilizing GPSS and the accessibility of an IBM 360/40 computer with GPSS V capability.

The major steps involved in the simulation program developed in this study are the following:

- a. Define and constrain the system
- b. Develop a program and execute
- c. Manipulate variables and analyze outputs

A description of each of these steps and their application in the development of the EW Operator Training System simulation are presented in detail in the remainder of this section.

DEFINE AND CONSTRAIN THE SYSTEM

The EW Operator Training System was defined by the EW TAEG team with the aid of EW planners. The conceptualized system is represented in Figure 3. There are seven types of students which flow through a total of 21 different learning modules. The system will be/is constrained by requirements promulgated by Chief of Naval Operations (CNO), Bureau of Naval Personnel (BUPERS), Chief of Naval Education and Training (CNET) and any other agency that can control the input or specify the output of the system either in personnel requirements and/or dollars. The system is further constrained by the fact that each learning module will have lesson plans that will be completed either in a multi-media carrel, an operational trainer, or in a special procedures trainer (aircraft). A multi-media carrel is an individual study booth equipped with a slide projector, tape deck, synchronizing system for sound/slide programs, and an 8mm sound motion picture projector supported with programmed instruction and texts. An operational trainer is a training device in which trainee stations provide generalized representation of the functional capabilities of present and projected EW equipment. The system features student self-pacing through curriculum elements, active learning, immediate feedback, and defined remedial instructions. The special procedures trainers are two support aircraft with 20 student stations per aircraft for physiological student training purposes.

Thus the training environment is composed of the carrels, operational trainers, and support aircraft. The dynamic entities are associated with the student flow through the prescribed courses of instruction (see Figure 3). The data were initially developed by the EW planners using all available data and experience to date. As the system is installed and exercised, these data will be validated and revised accordingly.

LEARNING MODULE													
STUDENT INPUT		TRAINED OUTPUT											
SQUADRON E'W TRAINING OFFICER	SURFACE EWO	MARINES	CTT (ELINT)	NFO	EW	PROSPECTIVE CO'S, OPS/CIC OFFICERS	SQUADRON E'W TRAINING OFFICER	SURFACE EWO	MARINES	CTT (ELINT)	NFO	EW	PROSPECTIVE CO'S, OPS/CIC OFFICERS
SCHL INTRO/PRE-EXAM	X	X	X	X	X	X	X	X	X	X	X	X	X
MATHMATICS			*	*	*	*			*	*	*	*	
BASIC ELECTRONICS		X	X	X	X	X		X	X	X	X	X	
ELEC TRANS & RECEPT					*	*			*	*	*	*	
RADAR SYSTEM		X	X	X	X	X		X	X	X	X	X	X
PHYSIOLOGICAL & PSYC EVAL		X	X	X	X	X		X	X	X	X	X	X
FW FUNCT ORG PROCEED		X		X	X	X		X	X	X	X	X	
SIGNAL TO DEFENSE SYSTEMS		X	X	X	X	X		X	X	X	X	X	X
FW CONCEPTS		X	X	X	X	X		X	X	X	X	X	
FUNDAMENTAL ESM		X	X	X	X	X		X	X	X	X	X	X
ADVANCED ESM		X	X	X	X	X		X	X	X	X	X	
FUNDAMENTAL ESM SIM		X	X	X	X	X		X	X	X	X	X	
ADVANCED ESM SIM		X	X	X	X	X		X	X	X	X	X	
FUNDAMENTAL ECM		X		X		X			X		X		
ADVANCED ECM SIM		X	X	X	X	X		X	X	X	X	X	X
ADVANCED ECM		X	X	X	X	X		X	X	X	X	X	
ADVANCED MISSION OPNS		X	X	X	X	X		X	X	X	X	X	
CAREER INFO		X	X	X	X	X		X	X	X	X	X	X

DEVELOP A PROGRAM AND EXECUTE

Each transaction in the EW operator training simulation program represents a student. Each student has certain characteristics which were described by the 13 possible characteristics listed in Figure 4. Subroutines in the main program represent two student scheduling procedures: (1) lesson plan, either in carrel or trainer, or (2) carrel, followed by trainer and back to carrel again.

Two smaller programs control time elements of the overall program. The first one controls the time of day or hours per training period and the other controls the number of days to be simulated. An exponential distribution function with different mean rates controls the student input rate. The type of student entering is determined by a discrete numerical function.

The cumulative exponential or Poisson distribution function which describes student arrivals is illustrated in Figure 5. A Poisson or exponential distribution states that the probability of k arrivals in time t is $e^{-t/m} (t/m)^k / k!$ where m is the mean interarrival time. The probability that the next arrival will occur within t time units is $1 - e^{-t/m}$. In Figure 5 the probability value appears along the horizontal axis and t/m along the vertical axis. The interarrival time is obtained by multiplying the function value by m . The function gives results which are accurate to within 0.1 percent for $45 \leq m \leq 250$ and 1.0 percent for $m \leq 45$.

The type of student, or student mix, entering the school is determined by a discrete numerical function. The student input population or percentage mix of student types was specified by the EW planners. Figure 6 graphically depicts the student mix. By using the GPSS function argument, RN 1, the following results are obtained: Squadron EW Training Officer if $0 \leq \text{RN1} \leq .0376$, Surface EWO if $.0367 < \text{RN1} \leq .0827$, and so forth.

TAEG REPORT NO. 11-2

In the main program each transaction equals a student with 13 possible characteristics as follows:

Student M1, P1, P2,P12
(Transaction)

Where:

M1 - The Standard Numerical Attribute (SNA) for the transit time of the student currently being processed.

P1 - Student Type - There are presently seven possible student types:
(1) Squadron EW Training Officer, (2) Surface EWO, (3) Marines, (4) CTT(ELINT),
(5) NFO, (6) EW, (7) Prospective CO's and OPS/CIC Officers.

P2 - Facilities Counter - Locates which one of 90 possible trainers is unoccupied.

P3 - Number Counter - Determines which class schedule (learning track) to put student through for the first nine classes or learning modules.

P4 - Learning Module Number - Student is placed in a particular module (26 possible) according to his prescribed learning track.

P5 - Lesson Plan Number - Used for first nine modules and is a function of the particular learning module.

P6 - Average time for lesson plan within module.

P7 - Time deviate for each lesson plan.

P8 - Special Number Counter for particular Lesson Plan Groups (carrel vs. operational trainer) within module. Basically, same as P3, except this counter is peculiar to modules 10 through 26.

P9 - Lesson Plan Number - used for modules 10 through 26; concerns both carrel and operational trainer.

P10 - Not used (available for other desirable attributes).

P11 - Time student enters school.

P12 - Subroutine transfer counter.

Figure 4. Student Characteristics

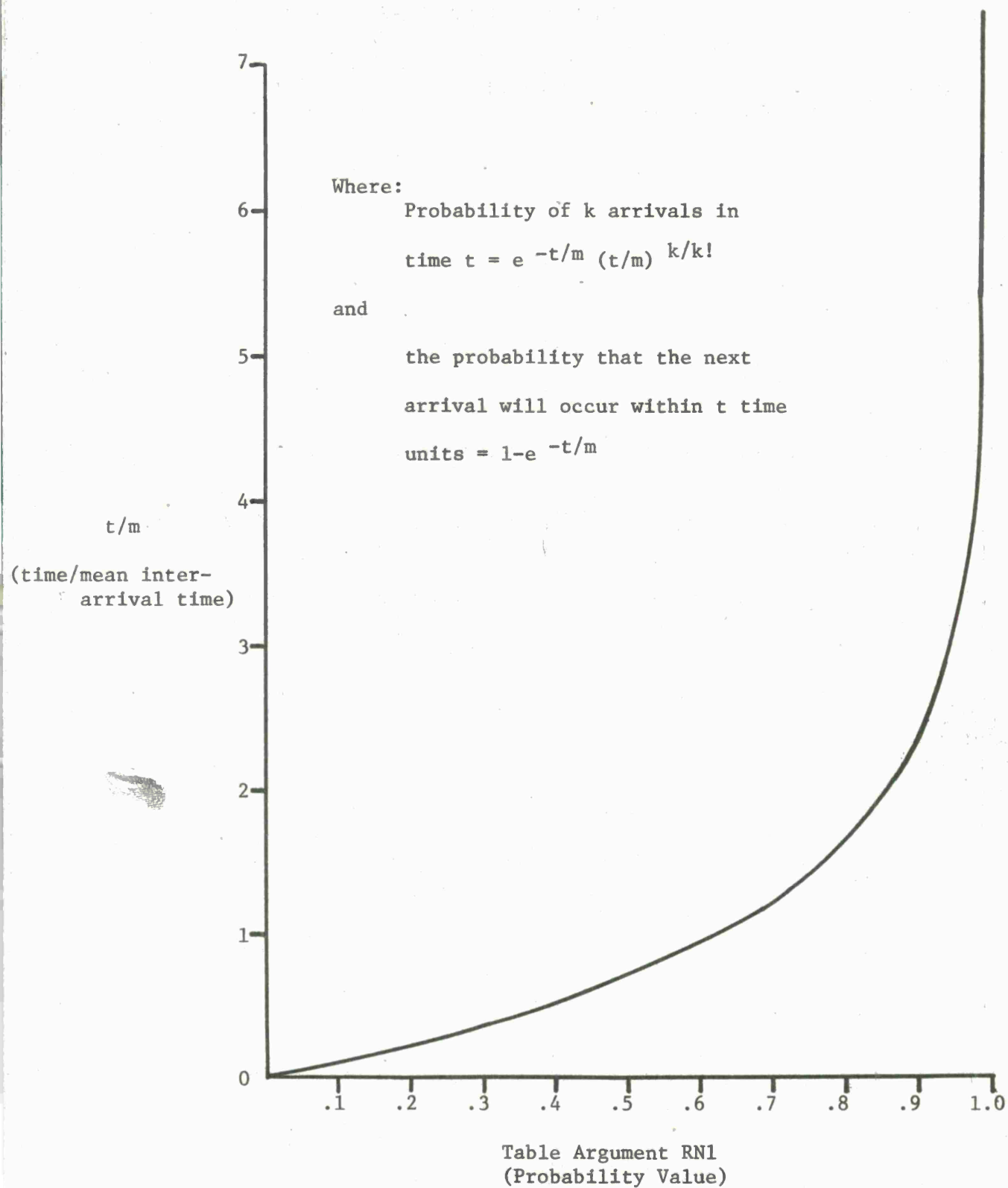
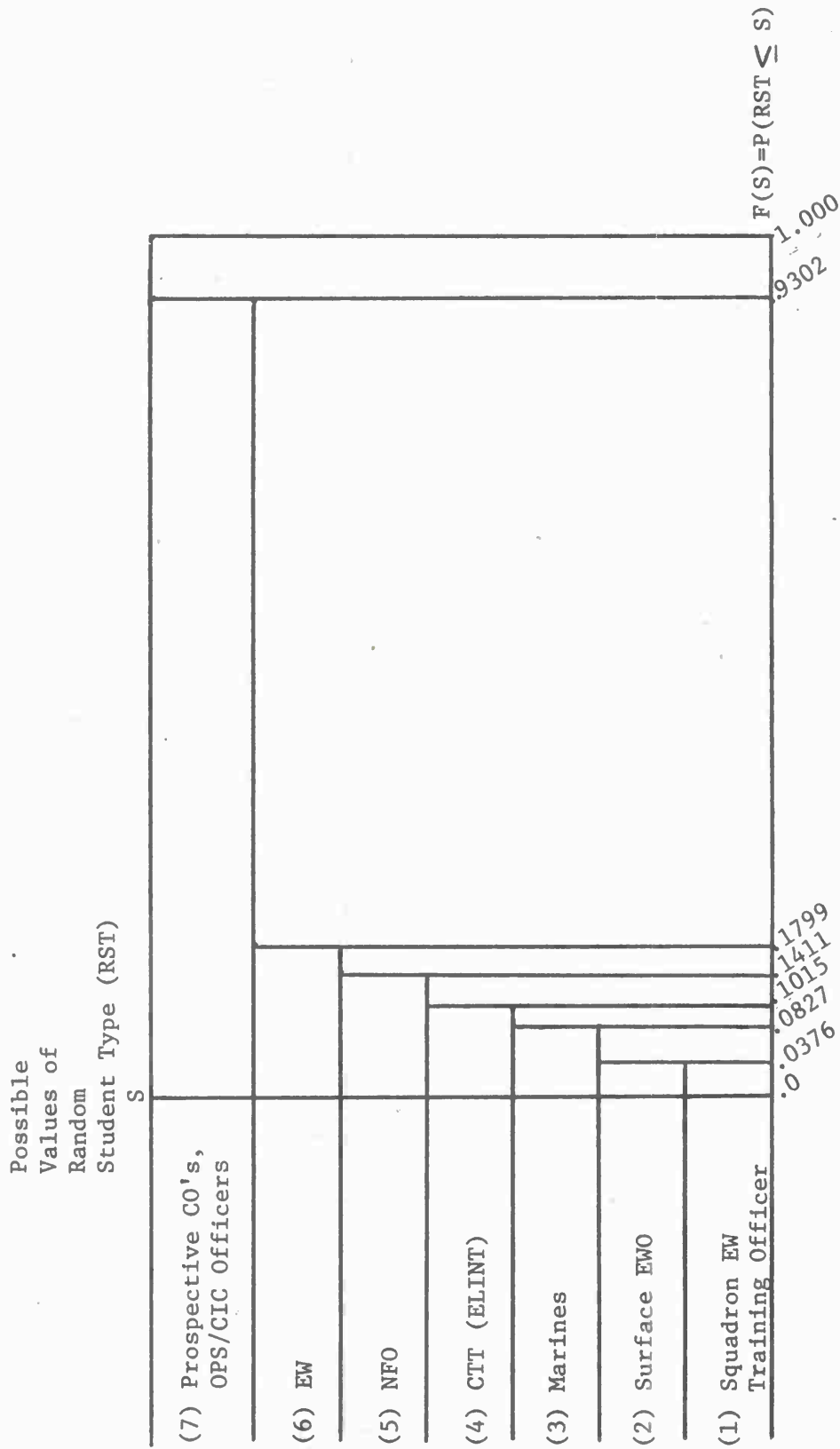


Figure 5. Cumulative Exponential or Poisson Distribution Function to Describe Student Arrivals



RN1 = Cumulative Probability
(Random Number 1)

Example: If .1411 < RN1 ≤ 1799, student type is (5) NFO

Figure 6. Student Mix

Each type of student has an individual track set up by one of two student schedule subroutines, which uses a list numerical function to pick the classes or modules, the number of lesson plans, and the mean times as well as deviations about that time in the lesson plan. Boolean variable entities are used at key decision blocks to determine individual student paths through the network.

The overall concept of the simulation program for this particular application can be better understood by referring to Figure 7 which gives a Macro view of the model. Basically, there are three phases of the student flow which are of concern in the program: an initiation phase, an execution phase, and a completion phase. The student arrival and type are determined as described above. The specific network track is specified by the conceptual system shown in Figure 3. As the student progresses, he is assigned to the proper module and is processed through that module according to a normative distribution of lesson plan times. If the module is occupied, he waits in a queue until it is available. Intrinsic in this scheduling is the consideration of length of the school day. If the student is currently in a module he will complete that particular lesson before leaving. This process is iterative in nature until the prescribed network path is completed. Statistical data are compiled for all phases of his progress.

MANIPULATE VARIABLES AND ANALYZE OUTPUTS

The manipulation of variables and the resultant analysis of outputs is an ongoing task. Initially, the system was run with certain inputs. The outputs were then observed to determine adequacy with the specified requirements. Figure 8 illustrates the inputs/outputs/constraints of the system. By manipulating the variables under his control, the manager can determine

Completion Phase

Execution Phase

Initiation Phase

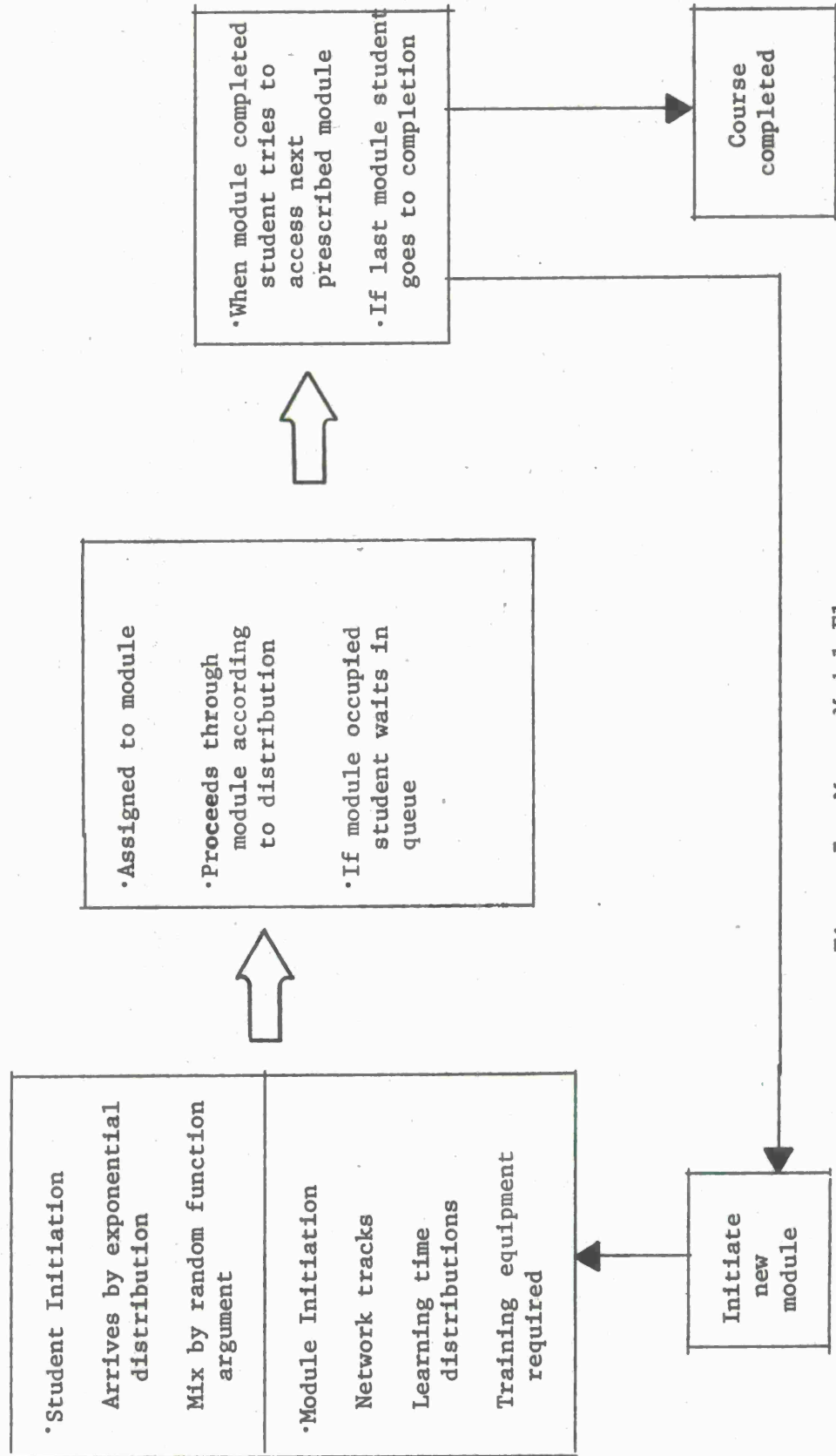


Figure 7. Macro Model Flow

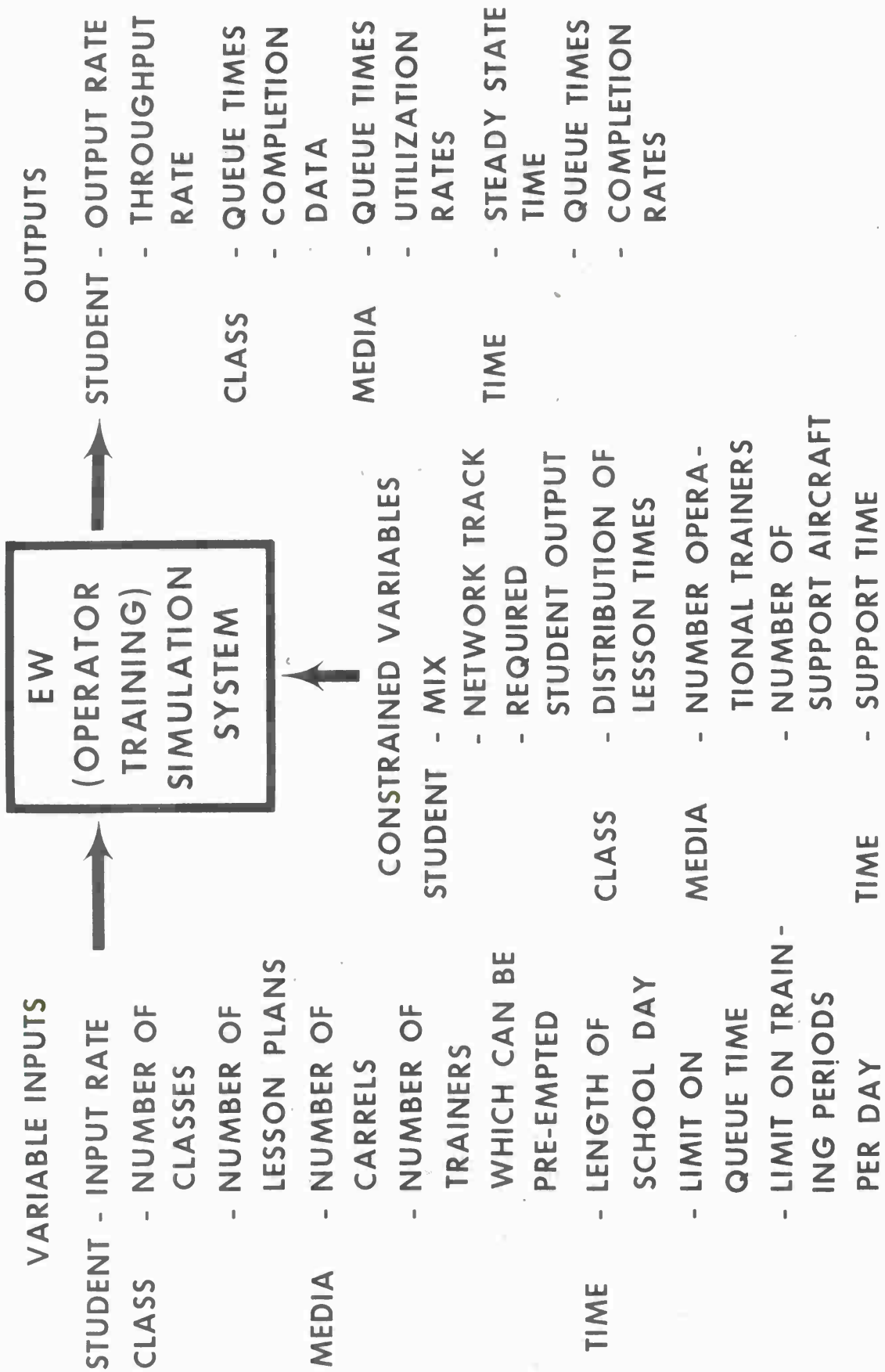


Figure 8. Input/Output/Constraint Diagram

what effect this will have on the output. To date, the input variables have been held constant except for student input rate in order to examine the capacities of the conceptualized system. The results of this exercise are presented in Section III.

SECTION III

RESULTS

Since the requirement for trained EW operators by number and type was exogenous to their system (specified by CNO), this was considered to be the driving force of the system. This coupled with an austere budget, yet relatively free to determine, or at least suggest, how that budgeted money would be expended on training media, the planners needed to insure that the conceptualized system would meet the required output within the dollar constraints. The range of items under consideration is shown in Figure 8.

In order to perform comparative analyses of system capabilities or to compare alternative system strategies, certain input variables should remain constant together with the constrained variables, while other key controllable input variables are manipulated.

The conceptual system as described in Figure 3 was analyzed by the EW planners in TAEK to determine the mix of media for each module which would satisfy the overall training requirements within the dollar constraints. Initially, the number of multi-media carrels was set at 220, the number of operational trainers was set at 90, and the number of support aircraft was set at 2 with 30 student positions per aircraft. By keeping variables such as the number of classes, lesson plans per class, and the distributions of time for each lesson plan constant and varying the student input rate, the planners were able to get an idea of the capacity and limits of the conceptualized system.

Once the conceptual system was adequately defined and constrained, the simulation was reduced to the iterative process of execution, manipulation, and analysis of the outputs for the program. Three student input rates were simulated and compared. The input rates were four, six, and eight

TAEg REPORT NO. 11-2

students per day, with the arrival times and appropriate mix determined by the methods described in Section II.

A brief discussion of the results for each of the three input rates is presented below. Details of the simulation program, i.e., program listing, flow charts, and sample output, are contained in Appendices A, B and C respectively. Standard GPSS output provides a great amount of tabulated statistical data on the system being simulated. In this particular application much of these data were not relevant to the problems under consideration. However, in the future, much of these data may prove useful for the "fine tuning" of the system once it becomes operational.

a. Four Students Per Day

At an input rate of four students per day the most significant output of the simulation was the fact that no queues were observed. Students proceeded through the system without any delays caused by the unavailability of media. Under these conditions the observed completion times are considered to be optimal. The completion times for an input rate of four students per day are summarized in Table 1.

TABLE 1. COMPLETION TIMES FOR AN INPUT RATE OF FOUR STUDENTS PER DAY

Type Student	Completion Time (in days)			Standard Deviation
	Maximum	Minimum	Mean	
Squadron EW Training Officer	38	36	36.67	0.707
Surface EWO	39	34	36.71	1.601
Marines	53	52	52.33	0.577
CTT (ELINT)	48	41	43.82	2.085
NFO	53	51	51.71	0.915
EW	54	41	47.17	2.855
Prospective CO's, OPS/CIC Officers	25	21	22.82	1.128

These figures not only represent the expected average completion time for each type of student in the system defined but give support to the efficacy of employing individualized, self-paced instruction. These average completion times represent a reduction in instruction time over the traditional lock-step type of instruction of approximately 30 percent. For example, a representative EW traditional lock-step form of instruction would require approximately 65 hours, whereas in our example the time required is approximately 47 hours, or a reduction in time of about 28 percent.

b. Six Students Per Day

When the input rate is increased from four to six students per day, queues begin to develop. However, the queues have a negligible effect on the completion times associated with each student type. The reason for this is that the queues affect an insignificant number of students. This is shown by the following output data:

<u>Type of facility</u>	<u>Average length of queue</u>	<u>Percent students affected</u>
Carrel	44.58 minutes	1.10
Operational Trainer	41.97 minutes	0.60

This means that 98.9 percent of the students in the system experienced no queuing associated with carrels and 99.4 percent had no queues with operational trainer usage. While the net effect on average completion times for all students, expressed in days, was not significant, any queue over 30 minutes was arbitrarily considered serious from a student motivational standpoint. Detailed analysis of the system output data associated with each queue could remedy this situation by the addition of, or the manipulation of, media associated with the queue. Since the average completion times were considered to be more significant indicators of system performance, and the

minor fluctuations observed in these times were attributed more to the errors associated with the GPSS random number arguments and distribution times than to the queues, efforts to reduce the queues were deemed unnecessary.

c. Eight Students Per Day

The training system continued to perform as prescribed when the input rate was increased to eight students per day, with the average completion rates remaining stable. The queues began to become significant at this input rate--approaching three hours for the carrels and one hour for operational trainers. However, the percent of students experiencing queues was still relatively low; i.e., 5.6 percent for carrels and 4.7 percent for operational trainers. Even though the queues appear excessive, the time compression resulting from the use of individualized self-paced instruction versus traditional instruction would indicate that these queues may be tolerable. If a 30 percent reduction in instruction time is anticipated, then a queue of three hours 5.6 percent of the time does not seem significant. Before any adjustments are made to reduce the queues, tradeoffs should be considered between the cost of adding media, the disadvantages of a student waiting for the media, the overall effect on the student's completion rate, and so on.

Simulation runs utilizing input rates greater than eight students/day were not attempted since the computational limits of the processing equipment were being approached. With an input rate of eight students/day there were approximately 500 students in the system which had to be monitored and the computer processing time became prohibitive. Most applications of simulation to training systems should not be as complex as the system examined in this

study and, therefore, should not present this problem. If it does prove prohibitive, larger processing equipment should be obtained to conduct the simulation.

The results of these simulation runs indicate that the conceptual EW Operator Training System as defined and constrained will have the capability to meet the specified system requirements. As shown in Table 2, the average completion times are fairly constant over the input rates chosen. While queues develop for the six and eight students per day input rates, the impact on the average completion times is not readily discernible. The queues do impact the output of the system since more people are maintained in the system as the input rate and the queues increase. Table 3 represents an extrapolated summary of expected annual output for the system. With an input rate of four students per day, 187 students occupy the system once steady-state conditions are reached. For six and eight students per day, the number of students in the system increases to 314 and 438 respectively. There appears to be no need to increase quantities of training media to reduce the queues associated with higher input rates since the lower rates will satisfy the specified output requirements. Once the conceptual system becomes operational, however, some manipulation or addition of media for certain modules may prove desirable as experience is gained. A more accurate emulation of the system will be possible after real world systems data are available and the assumptions and estimates reflecting system performance are verified.

TABLE 2. AVERAGE COMPLETION TIMES (IN DAYS)

<u>Type Student</u>	<u>Input Rate (Students Per Day)</u>		
	<u>4</u>	<u>6</u>	<u>8</u>
Squadron EW Training Officer	36.6	37.4	37.3
Surface EWO	36.7	36.6	37.5
Marines	52.3	49.2	51.7
CTT (ELINT)	43.8	44.0	44.3
NFO	51.7	53.4	52.6
EW	47.2	47.4	47.6
Prospective CO's, OPS/CIC Officers	22.8	22.2	23.0

TABLE 3. EXPECTED ANNUAL EW OPERATOR TRAINING SYSTEM OUTPUT

<u>Type Student</u>	<u>Input Rate (Students Per Day)</u>		
	<u>4</u>	<u>6</u>	<u>8</u>
Squadron EW Training Officer	32	47	58
Squadron EWO	38	56	70
Marines	16	23	29
CTT (ELINT)	34	50	61
NFO	33	48	59
EW	640	935	1157
Prospective CO's, OPS/CIC Officers	<u>60</u>	<u>87</u>	<u>108</u>
Totals	853	1246	1542

SECTION IV

CONCLUSIONS

Simulation of a training system by computer can provide useful analytical capability which enhances the manager's ability to assess requirements and capacities while formulating various alternatives to a problem.

The simulation technique described and applied in this report provides a powerful analytical capability for EW planners. Changes in student input rates can be examined systematically to assess the effect of achieving personnel and resources in steady state of the system. In addition, the effects of changing learning modules, lesson plans, and training support equipment on the training system can be determined. The queuing effects expected at the carrels or trainers can also be examined as a function of changes in student mix, input rates or as other pertinent variables are changed. The training manager can get a reasonable idea of the different student throughput rates and how the throughput rates are affected by changes in the input variables. The list of system entities and how they can be analyzed is extensive. The particular problem facing the manager dictates the area of analysis. The simulation described here provides the vehicle for such analysis. During the system definition, the manager is forced to analyze his system. This forced system analysis provides training management perspectives heretofore unavailable.

It should be noted that simulation models do not yield absolute solutions to problems. This generic type of model only replicates the system described to the level of detail it is designed. It does, however, provide an invaluable tool for management to assess the validity or consequences of assumptions, thus enabling a more systematic and realistic solution to a

planning problem. The ultimate decision-making responsibility still rests with the manager; simulation and other analytical techniques are only tools for increasing the effectiveness of the manager.

SECTION V

RECOMMENDATIONS

The power of simulation as a planning tool for training system consideration has been demonstrated in this study. However, before continued effort is expended either on this specific application, i.e., EW operator training, or on the modification of the simulation programs to a generalized individualized self-paced instructional system, detailed analysis of assumptions made and the relevance of particular outputs is needed. Specific problems, which are suited to analysis by simulation of the system, must be examined on their individual merits. This case-by-case assessment would allow the formatting of output data to satisfy the problem needs and allow rapid assessment and possible solutions.

Training plans, and the formulation of training plans, should include simulation as well as other analytical techniques, as applicable. "As applicable" implies that the analysis warrants the potential benefits or cost savings accrued from the application of the technique. Training plans, especially for conceptual systems, need more accurate ways of determining the capacities and requirements of proposed training systems.

In addition to providing real quantifiable data for comparison in planning for training, simulation can provide realistic data for budget considerations. These data, for example, would provide timely inputs to the Program Objective Memorandum (POM).

The ability and requirement "to do" simulations should be undertaken by staff groups, either military or civilian, which have programming and system analysis capabilities.

TAEG REPORT NO. 11-2

The use of simulation for other specific applications should be addressed as the need arises. The installation of individualized self-paced instructional systems in the Navy is still in the beginning stages. As these instructional systems become prominent in the Navy, the need for employing analytic tools, such as simulation in the design for and control of training, is clear and it is urgent.

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TAEG REPORT NO. 11-2

APPENDIX A

TAEG REPORT NO. 11-2

CONTROL CARDS

This program was run on an IBM 360/40 using GPSS V with the following control cards:

```
//NAVY JOB TIME=600
//EXECS EXEC PGM=DAGO1V,PARM=B,TIME=600
//DOUTPUT DD SYSOUT=A
//DINTERO DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//DSYMTAB DD UNIT=SYSDA,SPACE=(TRK,10,10))
//DREPTGEN DD UNIT=SYSDA,SPACE=(TRK,(10,10))
//DINTWORK DD UNIT=(SYSDA,SEP=(DINTERO)),SPACE=(TRK,(10,10))
//DRDSAVEO DD UNIT=2400,VOL=SER=NEWTAP,LABEL=(,NL),DISP=(OLD,PASS)
//DRDSAVEI DD UNIT=2400,VOL=SER=OLDTAP,LABEL=(,NL),DISP=(OLD,PASS)
//DXREFDS DD UNIT=SYSDA,SPACE=(TRK,(1,1))
//DINPUT1 DD *
REALLOCATE VAR,11,FSV,20,HSV,20,CHA,15,BLO,250,FAC,100
REALLOCATE STO,10,QUE,30,LOG,10,TAB,10,FUN,20,GRP,0,BVR,24
REALLOCATE COM,56868
```

BOOLEAN VARIABLES

```

1  BVARIABLE ((P1'E'3)+(P1'E'4)+(P1'E'6))*(P4'E'1)
2  BVARIABLE ((P1'E'3)+(P1'E'4)+(P1'E'6))*(P4'E'2)
3  BVARIABLE ((P1'E'3)+(P1'E'5)+(P1'E'6))*(P4'E'5)
4  BVARIABLE ((P1'E'7)*(P4'E'25))+(P4'E'26)
5  BVARIABLE FNI61+FNI62+FNI63+FNI64+FNI65+FNI66+FNI67+FNI68+FNI69
6  BVARIABLE FNI70+FNI71+FNI72+FNI73+FNI74+FNI75+FNI76+FNI77+FNI78
7  BVARIABLE FNI79+FNI80+FNI81+FNI82+FNI83+FNI84+FNI85+FNI86+FNI87
8  BVARIABLE FNI88+FNI89+FNI90
9  BVARIABLE BV5+BV6+BV7+BV8
10 BVARIABLE (P1'E'17)*((P8'E'19)+(P8'E'23))+BV11+(BV12*BV13)+BV14
11 BVARIABLE ((P1'E'13)*(P8'E'32))
12 BVARIABLE ((P1'E'3)+(P1'E'4)+(P1'E'5)+(P1'E'6))
13 BVARIABLE ((P8'E'26)+(P8'E'35))
14 BVARIABLE (P1'E'17)*((P8'E'14)+(P8'E'13))
15 BVARIABLE ((P1'E'1)*(P8'E'39))+BV18+BV16+BV17
16 BVARIABLE ((P1'E'3)+(P1'E'5)+(P1'E'6))*(P8'E'42)
17 BVARIABLE ((P1'E'17)*(P8'E'18))+BV23
18 BVARIABLE (P1'E'12)*(P8'E'37)
19 BVARIABLE (P1'E'17)*((P8'E'18)+(P8'E'22))+BV20+(BV12*BV21)+BV22
20 BVARIABLE (P1'E'13)*(P8'E'31)
21 BVARIABLE ((P8'E'25)+(P8'E'34))
22 BVARIABLE (P1'E'17)*((P8'E'13)+(P8'E'12))
23 BVARIABLE ((P1'E'14)*(P8'E'40))

```

TAEG REPORT NO. 11-2

VARIABLES, MATRIX, STORAGE

1	VARIABLE	15-F1-F2-F3-F4-F5-F6-F7-F8-F9-F10-F11-F12-F13-F14-F15
2	VARIABLE	12-F16-F17-F18-F19-F20-F21-F22-F23-F24-F25-F26-F27
3	VARIABLE	12-F30-F31-F32-F33-F34-F35-F36-F37-F38-F39-F40-F41
4	VARIABLE	12-F43-F44-F45-F46-F47-F48-F49-F50-F51-F52-F53-F54
5	VARIABLE	12-F56-F57-F58-F59-F60-F61-F62-F63-F64-F65-F66-F67
6	VARIABLE	12-F69-F70-F71-F72-F73-F74-F75-F76-F77-F78-F79-F80
7	VARIABLE	09-F82-F83-F84-F85-F86-F87-F88-F89-F90
8	VARIABLE	V1+V2+V3+V4+V5+V6+V7+V10
9	FVARIABLE	MP11/48
10	VARIABLE	06-F29-F42-F55-F68-F81-F28

1	MATRIX	H,28,7
2	MATRIX	H,1,7
3	MATRIX	H,1,1

INITIAL LS1

STORAGE S1,220/S2,90/S3,50

TAEG REPORT NO. 11-2

FUNCTIONS

SETO FUNCTION P3,L18 SQDN EW TRNG OFFICER SCHEDULE
4/6/7/8/9/10/11/12/13/14/17/18/19/20/21/22/25/26

SEWO FUNCTION P3,L16 SURFACE EWO TRAINING SCHEDULE
3/4/6/7/9/10/11/12/13/14/17/18/21/22/25/26

CTTE FUNCTION P3,L21 CTT(ELINT) TRAINING SCHEDULE
1/2/3/4/6/7/8/9/10/11/12/13/14/15/16/17/18/21/22
25/26

PROCD FUNCTION P3,L13 PROSPECTIVE CO'S
6/7/9/12/13/14/17/18/21/22/23/24/25

CLASS FUNCTION P4,L26 TIMING FOR EACH CLASS
8/4/4/4/17/4/5/2/3/4/6/2/5/16/5/7/5/5
4/6/6/5/7/5/8/3

TIME FUNCTION P4,L26 DEVIATE
2/7/2/1/3/2/2/1/1/1/2/1/1/1/1/2/1/1/1/1/1/1/2
1/2/1

LOOP FUNCTION P4,L9 LOOPING WITHIN THE FIRST 9 CLASSES
1/22/17/9/1/4/3/18/13

GETIT FUNCTION P8,L46 LOOPING LESSON PLANS FOR MARINES,NFO,EW
5/7/2/1/1/2/1/1/2/1/1/1/2/1/3/1/1/2/2/21/4/1/1/
3/4/1/4/1/1/2/2/2/1/2/2/4/4/3/5/1/4/2/2/5/3/3

PCOX FUNCTION P8,L22 LOOPING LESSON PLAN FOR CO'S
21/4/1/1/4/1/1/2/2/2/1/2/2/3/5/1/4/2/2/5/3/3

SGEW FUNCTION P8,L41 LOOPING LESSON PLAN FOR SQDN EW TRNG OFFICER
5/7/2/2/1/1/2/1/1/2/1/1/1/2/1/3/1/1/2/2/21/4/1/1/
4/1/1/2/2/2/1/2/2/4/4/3/5/1/4/2/3/3

SUEWT FUNCTION P8,L39 LOOPING LESSON PLAN FOR SURFACE EWO
5/7/2/2/1/1/2/1/1/2/2/1/1/2/1/3/1/1/2/2/21/4/1/1/
4/1/1/2/2/2/1/2/2/3/5/1/4/2/3/3

ELINT FUNCTION P8,L42
5/7/2/2/1/1/2/1/1/2/1/1/1/2/1/3/1/1/2/2/21/4/1/1/
3/4/1/4/1/1/2/2/2/1/2/2/3/5/1/4/2/3/3

R2 FUNCTION RN2,D7
.0376,1/.0827,2/.1015,3/.1411,4/.1799,5/.9302,6/1.,7

EXPON FUNCTION RN1,C24 EXPONENTIAL PROBABILITY DISTRIBUTION
0/0/.1/.104/.2/.222/.3/.355/.4/.509/.5/.69/.6/.915/.7/1.2/.75/1.38/
.8/1.6/.84/1.83/.88/2.12/.9/2.3/.92/2.52/.94/2.81/.95/2.99/.96/3.2/
.97/3.5/.98/3.9/.99/4.6/.995/5.3/.998/6.2/.999/7/.9997/8

TAEG REPORT NO. 11-2

SUBROUTINES

CARRL

CARRL
WON

ASSIGN 12+,1
GATE LS KAY,ZIPE
QUEUE P4
QUEUE 27
ENTER 1
DEPART P4
DEPART 27
ADVANCE P6,P7
LEAVE 1
LOOP 9,WON
TRANSFER ,P12

ZIPE
GON

LINK HEME,FIFO,GON
GATE LS KAY
ADVANCE 2,FN\$EXPON
TRANSFER ,WON

SUBROUTINES

CAREL

CAREL	ASSIGN	12+,1
NOW	GATE LS	KAY,ZIPER
	QUEUE	P4
	QUEUE	27
	ENTER	1
	DEPART	P4
	DEPART	27
	ADVANCE	P6,P7
	LEAVE	1
	LOOP	5,NOW
	MSAVEVALUE	1+,P4,P1,1,H
	TRANSFER	,P12
ZIPER	LINK	HOME,FIFO,GONE
GONE	GATE LS	KAY
	ADVANCE	2,FN\$EXPON
	TRANSFER	,NOW

TAEK REPORT NO. 11-2

OTSTA

SUBROUTINES

OTSTA	ASSIGN	12+,1
GOTO	GATE LS	KAY, NONER
	QUEUE	P4
	QUEUE	28
	TEST NE	V8,0
	ENTER	2
	DEPART	P4
	DEPART	28
JAMES	ASSIGN	2+,1
	GATE NU	P2,FIND
	SEIZE	P2
	ADVANCE	P6,P7
	RELEASE	P2
	LEAVE	2
	TEST L	P2,90,INIAT
ZIP	LOOP	9,GOTO
	TRANSFER	,P12
NONER	LINK	INTO,FIFO,SUE
SUE	GATE LS	KAY
	ADVANCE	2,FN\$EXPON
	TRANSFER	,GOTO
INIAT	ASSIGN	2-,90
	TRANSFER	,ZIP
FIND	TEST L	P2,90,ZEROO
	TRANSFER	,JAMES
ZEROO	ASSIGN	2-,90
	TRANSFER	,JAMES

SUBROUTINES

ASIGN	ASSIGN	3+,1
ASIGN	TEST E	P1,1,++3
	ASSIGN	4,FN\$SETO
	TRANSFER	,++19
	TEST E	P1,2,++3
	ASSIGN	4,FN\$SEWO
	TRANSFER	,++16
	TEST E	P1,3,++3
	ASSIGN	4,P3
	TRANSFER	,++13
	TEST E	P1,4,++3
	ASSIGN	4,FN\$CTTE
	TRANSFER	,++10
	TEST E	P1,5,++3
	ASSIGN	4,P3
	TRANSFER	,++7
	TEST E	P1,6,++5
	TEST E	P3,23,++2
	ASSIGN	3+,2
	ASSIGN	4,P3
	TRANSFER	,++2
	ASSIGN	4,FN\$PROCO
	ASSIGN	6,FN\$CLASS
	ASSIGN	7,FN\$TIME
	TRANSFER	P,12,1

HOWRD

SUBROUTINES

HOWRD	ASSIGN	8+,1
	TEST E	P1,1,#+3
	ASSIGN	9,FN\$SQEW
	TRANSFER	,RON
	TEST E	P1,2,#+3
	ASSIGN	9,FN\$SUEWQ
	TRANSFER	,RON
	TEST E	P1,3,#+3
	ASSIGN	9,FN\$GETIT
	TRANSFER	,RON
	TEST E	P1,4,#+3
	ASSIGN	9,FN\$ELINT
	TRANSFER	,RON
	TEST E	P1,5,#+3
	ASSIGN	9,FN\$GETIT
	TRANSFER	,RON
	TEST E	P1,6,#+3
	ASSIGN	9,FN\$GETIT
	TRANSFER	,#+2
	ASSIGN	9,FN\$PCOX
RON	TRANSFER	P,12,1

TIME-ORIENTED PROGRAMS

	GENERATE	,,,1
NXDAY	ADVANCE	16
	LOGIC I	KAY
	ADVANCE	32
	TRANSFER	SBR, UNLKH, 12
	TRANSFER	,NXDAY

UNLKH	LOGIC I	KAY
	UNLINK	HOME, GONE, ALL
	UNLINK	HEME, GON, ALL
	UNLINK	BETA, INFO, ALL
	UNLINK	INTO, SUE, ALL
	UNLINK	TWO, GOLF, ALL
	TRANSFER	P, 12, 1

GENERATE	16
TERMINATE	1

DESTROY ABOVE XACT; DECRIMIT RUN TERM. COUNT

MAIN PROGRAM

```

STT  GENERATE 12,FN$EXPON
      ASSIGN  1,FN2
      MARK    11
      MSAVEVALUE 2+,1,P1,1,H
EVON  TRANSFER SBR,ASIGN,12
      ASSIGN  5,FN$LOOP
      TEST E  BV1,1,MOON
      TRANSFER .455,EVON,WHITE
MOON  TEST E  BV2,1,STAR
      TRANSFER .556,EVON,WHITE
STAR  TEST E  BV3,1,WHITE
      TRANSFER .700,EVON,WINN
WHITE TRANSFER SBR,CAREL,12
      TEST E  P4,9,EVON
TEPEE TRANSFER SBR,ASIGN,12
      TRANSFER SBR,HOWRD,12
      TRANSFER SBR,CARRL,12
      TEST E  BV15,0,THINK
      TEST E  BV10,1,IBM
      MSAVEVALUE 1+,P4,P1,1,H
      ASSIGN  3+,1
      TRANSFER ,TEPEE
IBM   TEST E  P4,12,IBMM
      MSAVEVALUE 1+,P4,P1,1,H
      TRANSFER ,TEPEE
IBMM  TRANSFER SBR,ASIGN,12
      TRANSFER SBR,HOWRD,12
      TRANSFER SBR,OTSTA,12
      TEST E  P4,20,*+3
      MSAVEVALUE 1+,P4,P1,1,H
      MSAVEVALUE 1+,19,P1,1,H
      TEST NE  P4,20,TEPEE
      TEST E  BV19,1,HIT
      MSAVEVALUE 1+,P4,P1,1,H
HIT   ASSIGN  3-,2
      TRANSFER ,TEPEE
THINK MSAVEVALUE 1+,P4,P1,1,H
      TEST E  P4,21,*+2
      MSAVEVALUE 1+,22,P1,1,H
      ASSIGN  3+,1
      TRANSFER SBR,ASIGN,12
      TRANSFER SBR,HOWRD,12
      TRANSFER SBR,CARRL,12
      MSAVEVALUE 1+,P4,P1,1,H
      TEST L  P4,23,JUNE
      TRANSFER SBR,ASIGN,12
      TRANSFER SBR,HOWRD,12
INN   GATE LS  KAY,WING
      QUEUE   P4
      QUEUE   28
      TEST E  BV9,1
TNOW  ASSIGN  2,61
MONEY GATE NI  P2,LOOK
      PREEMPT P2
      DEPART  P4
      DEPART  28
      ADVANCE P6,P7
      RETURN  P2

```

GO TO PHYSIOL AND PSYCHOL. ROUTINE

ADVANCED MISSION OPERATIONS OT

MAIN PROGRAM (CONT'D)

```

      LOOP      9,INN
      MSAVEVALUE 1+,P4,P1,1,H
      TRANSFER  ,GIRL
WING  LINK      BETA,FIFO,INFO
INFO  GATE LS    KAY
      ADVANCE   2,FN$EXPON
      TRANSFER  ,INN
LOOK  ASSIGN    2+,1
      TEST E    P2,91,MONEY
      TRANSFER  ,TNOV
WINN  GATE LS    KAY,GOLF
      QUEUE     P4
      GATE SNF   3
      ENTER     3
      DEPART    P4
      ADVANCE   P6,P7
      LEAVE     3
CROWN MSAVEVALUE 1+,P4,P1,1,H
      TRANSFER  ,EVON
GOLF  LINK      TWO,FIFO,GOLF
GOLF  GATE LS    KAY
      ADVANCE   2,FN$EXPON
      TRANSFER  ,WINN
JUNE  TRANSFER  SBR,ASIGN,12
      TRANSFER  SBR,HQWRD,12
      TRANSFER  SBR,CARRL,12
      MSAVEVALUE 1+,P4,P1,1,H
GIRL  TEST E    BV4,0,TAB
      TRANSFER  SBR,ASIGN,12
      TRANSFER  SBR,HQWRD,12
      TRANSFER  SBR,CARRL,12
      MSAVEVALUE 1+,P4,P1,1,H
      TRANSFER  ,GIRL
TAB   SAVEVALUE P1,V9
      TABULATE  P1
      TERMINATE
1  TABLE      X1,30,1,100
2  TABLE      X2,30,1,100
3  TABLE      X3,30,1,100
4  TABLE      X4,30,1,100
5  TABLE      X5,30,1,100
6  TABLE      X6,30,1,100
7  TABLE      X7,20,1,100
      START     225,,10
      SAVF
      END

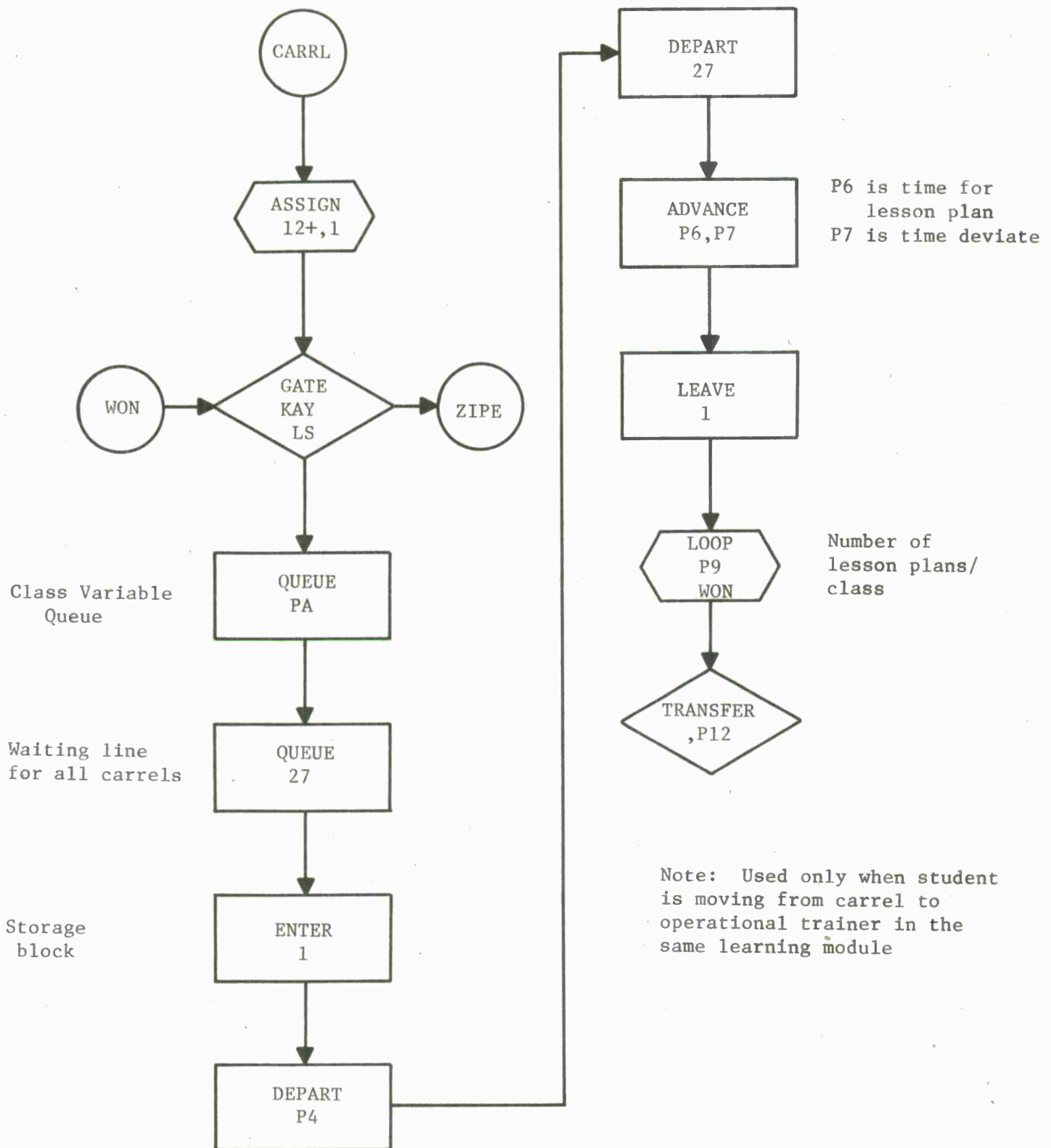
```

PHYSIOLOGICAL AND PSYCHOLOGICAL

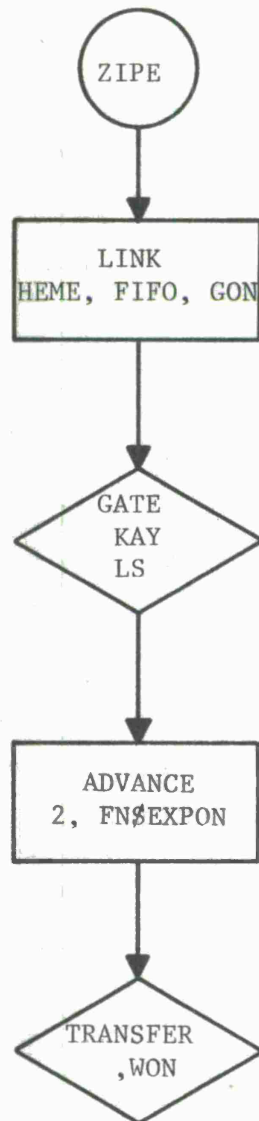
PSYCHOLOGICAL ROUTINE

TAEG REPORT NO. 11-2

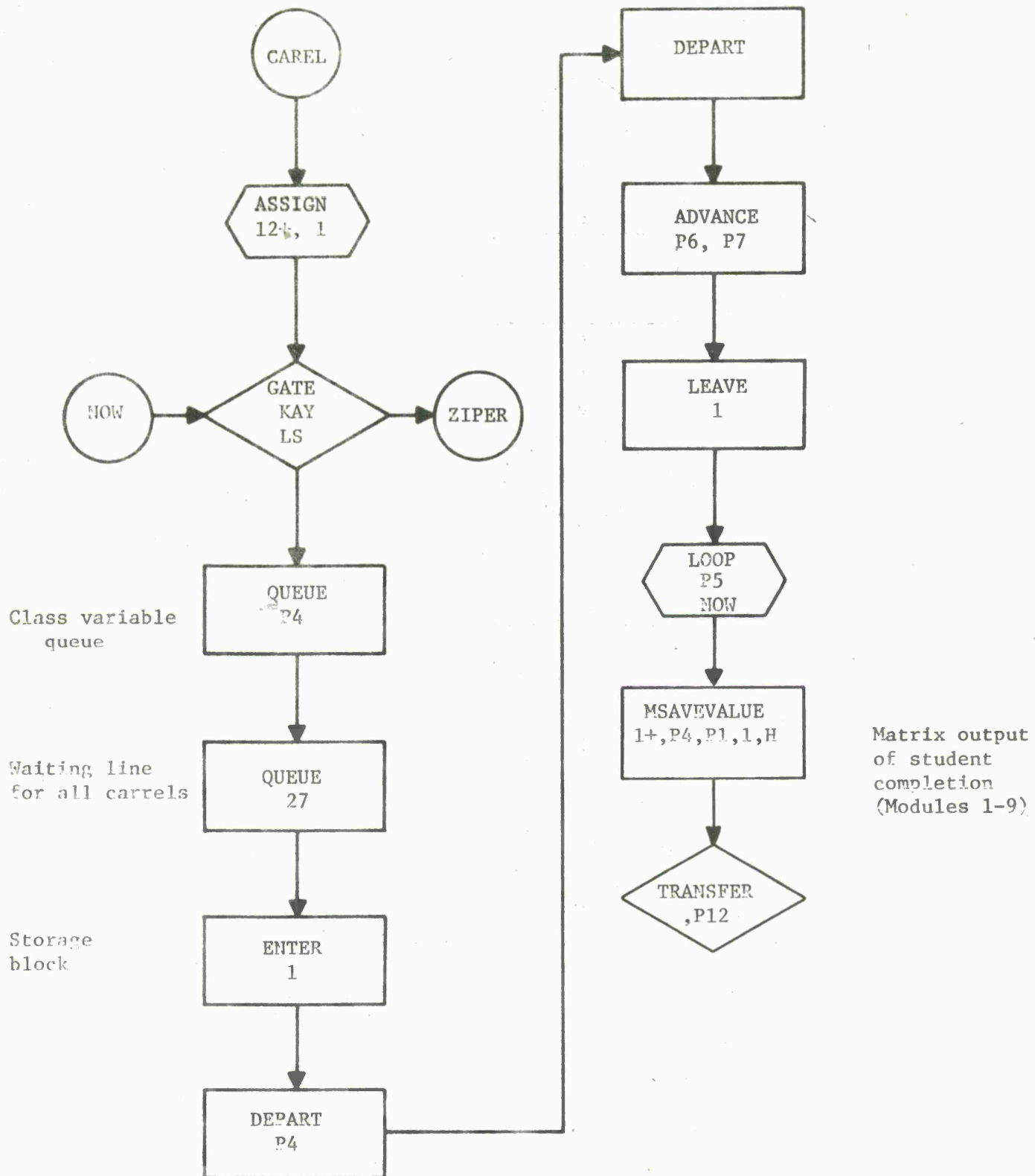
APPENDIX B



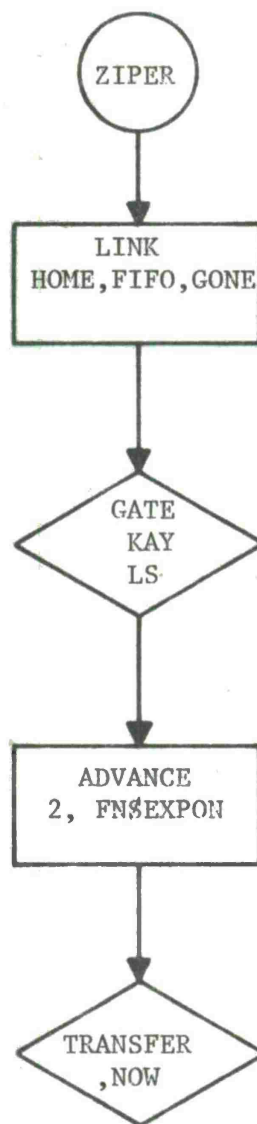
CARRL (Part 1)



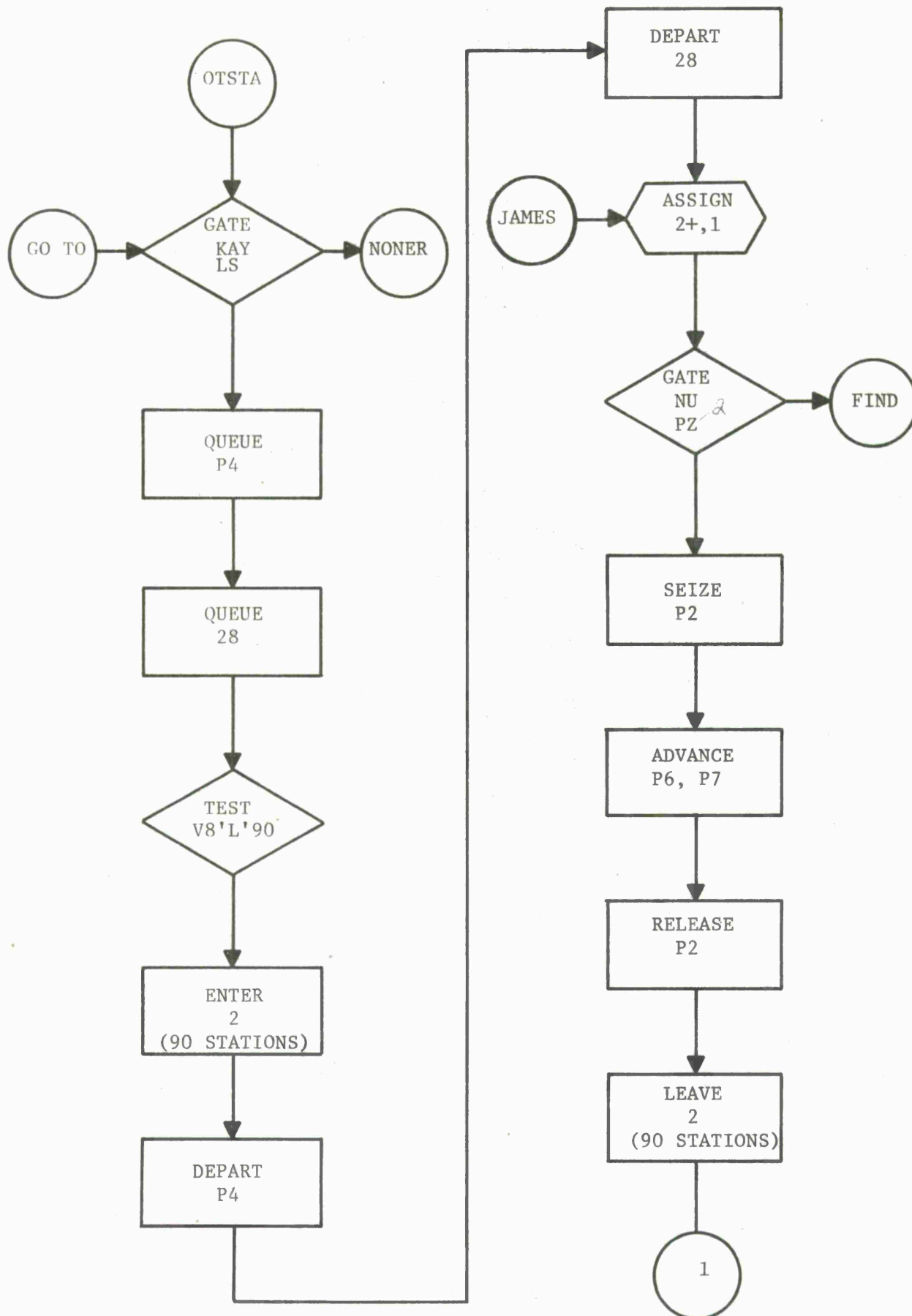
Note: Sends student home at the end of an 8-hour day and returns him to school the next day.

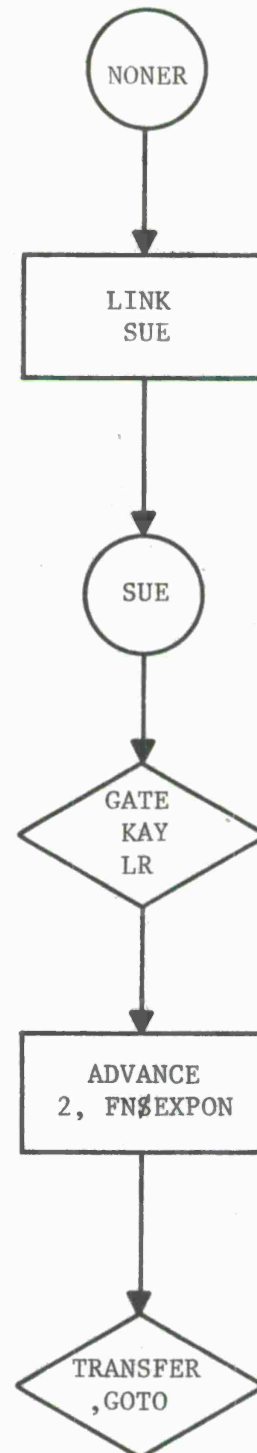
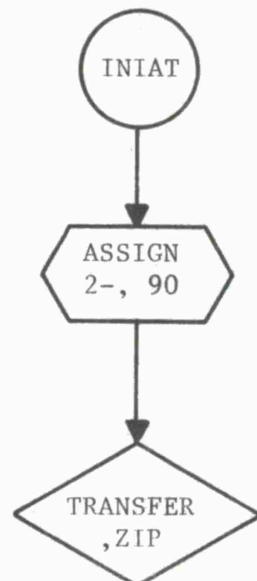
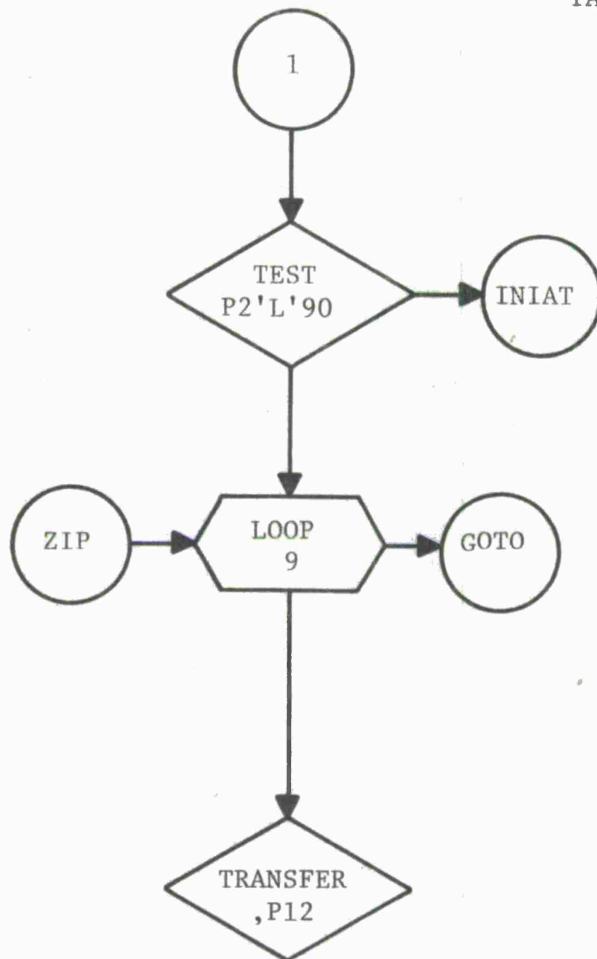


CAREL (Part 1)

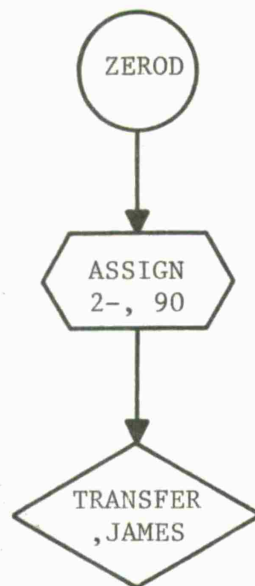
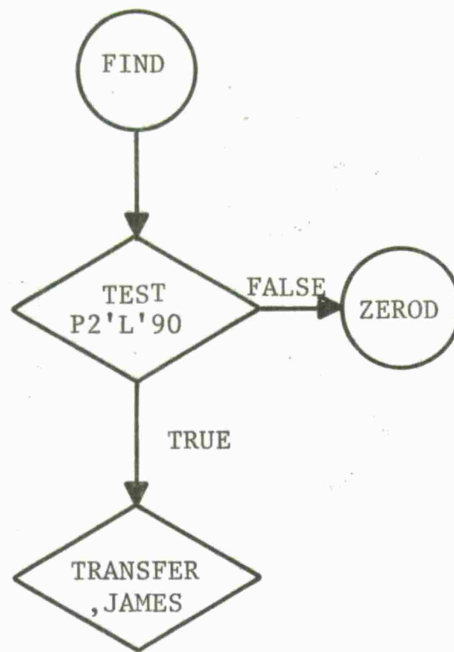


CAREL (PART 2)

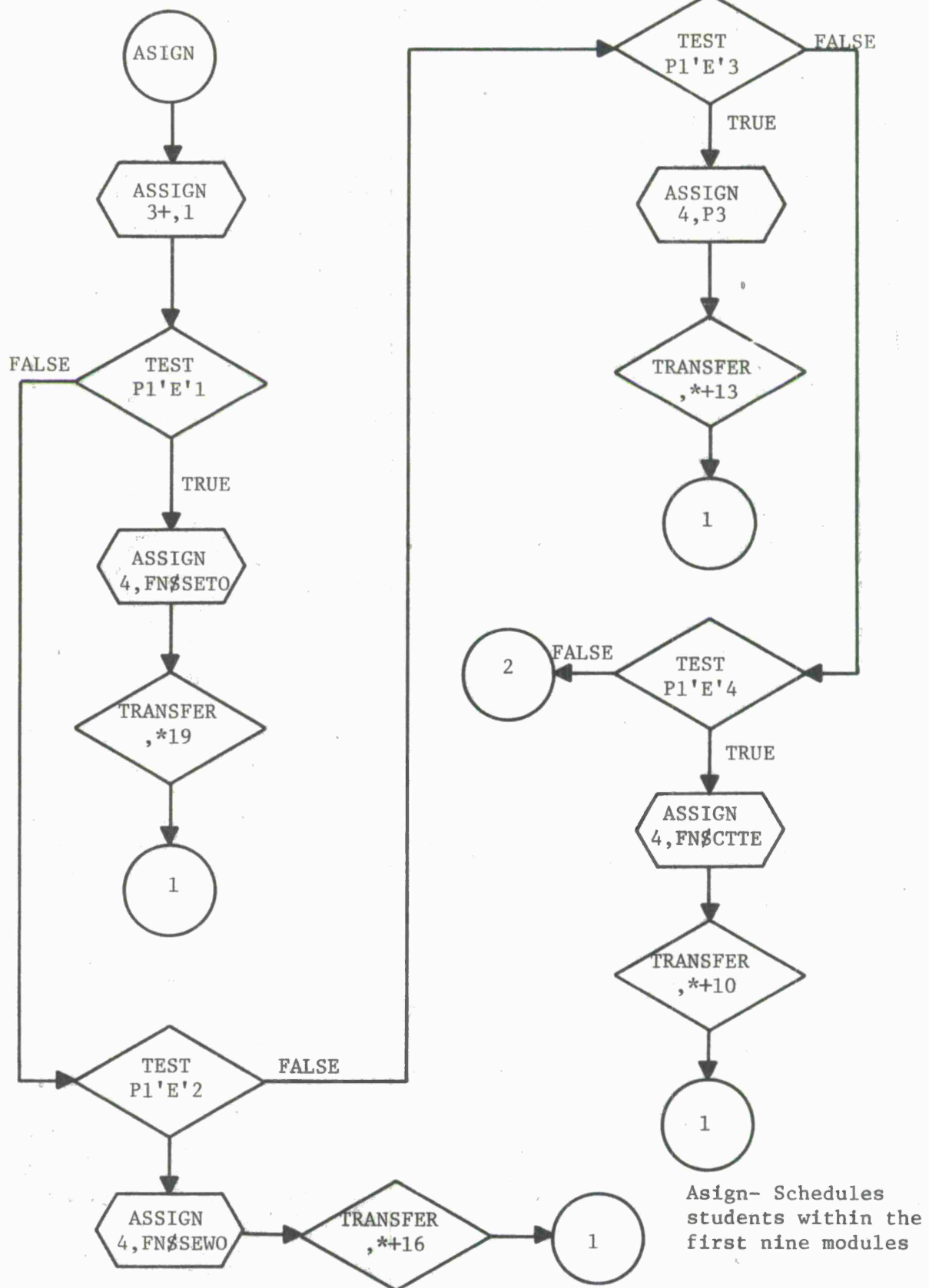




This routine sends students home at the end of an 8-hour day and puts them back into school at the beginning of the next day.

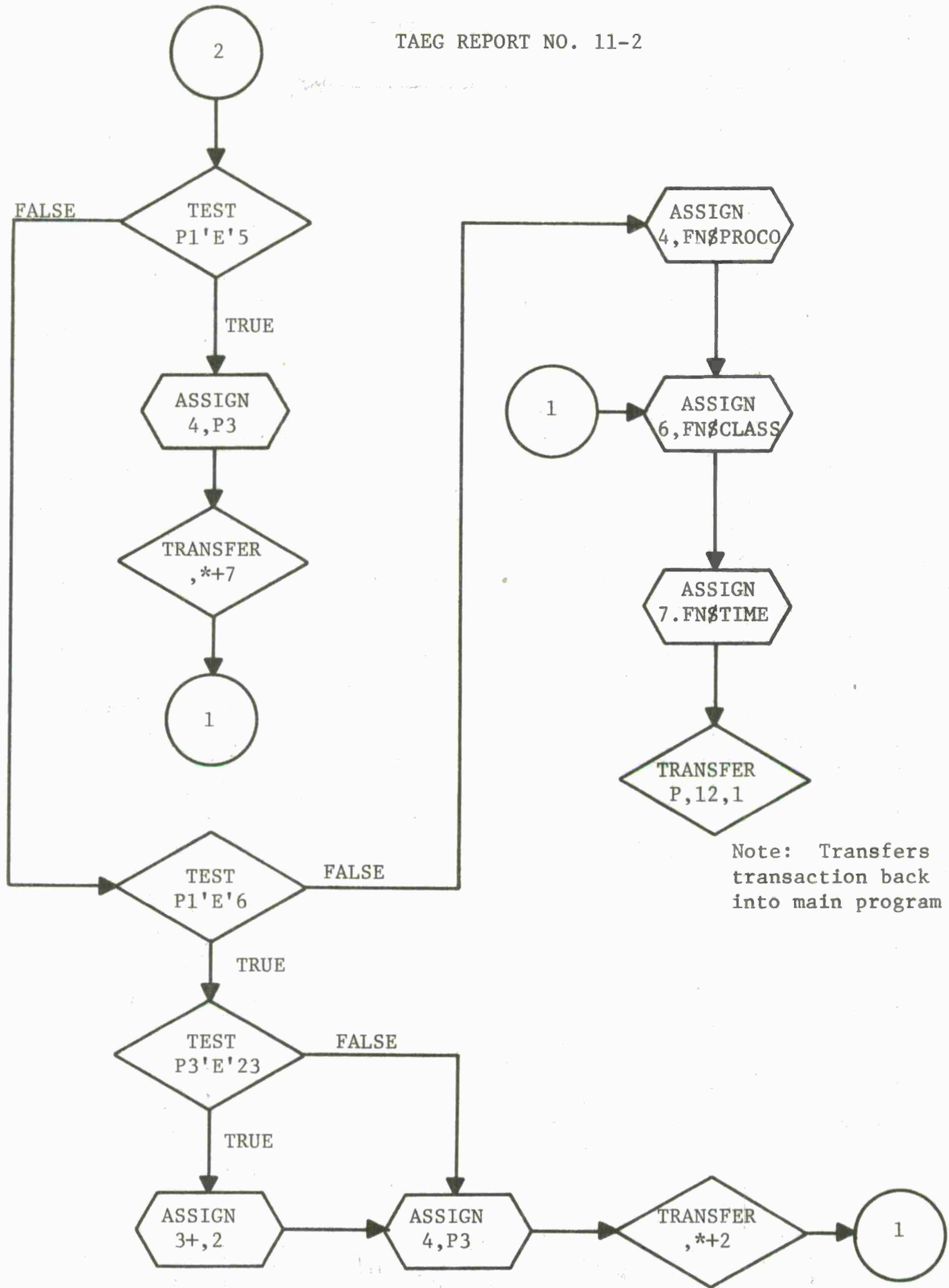


OTSTA (PART 3)

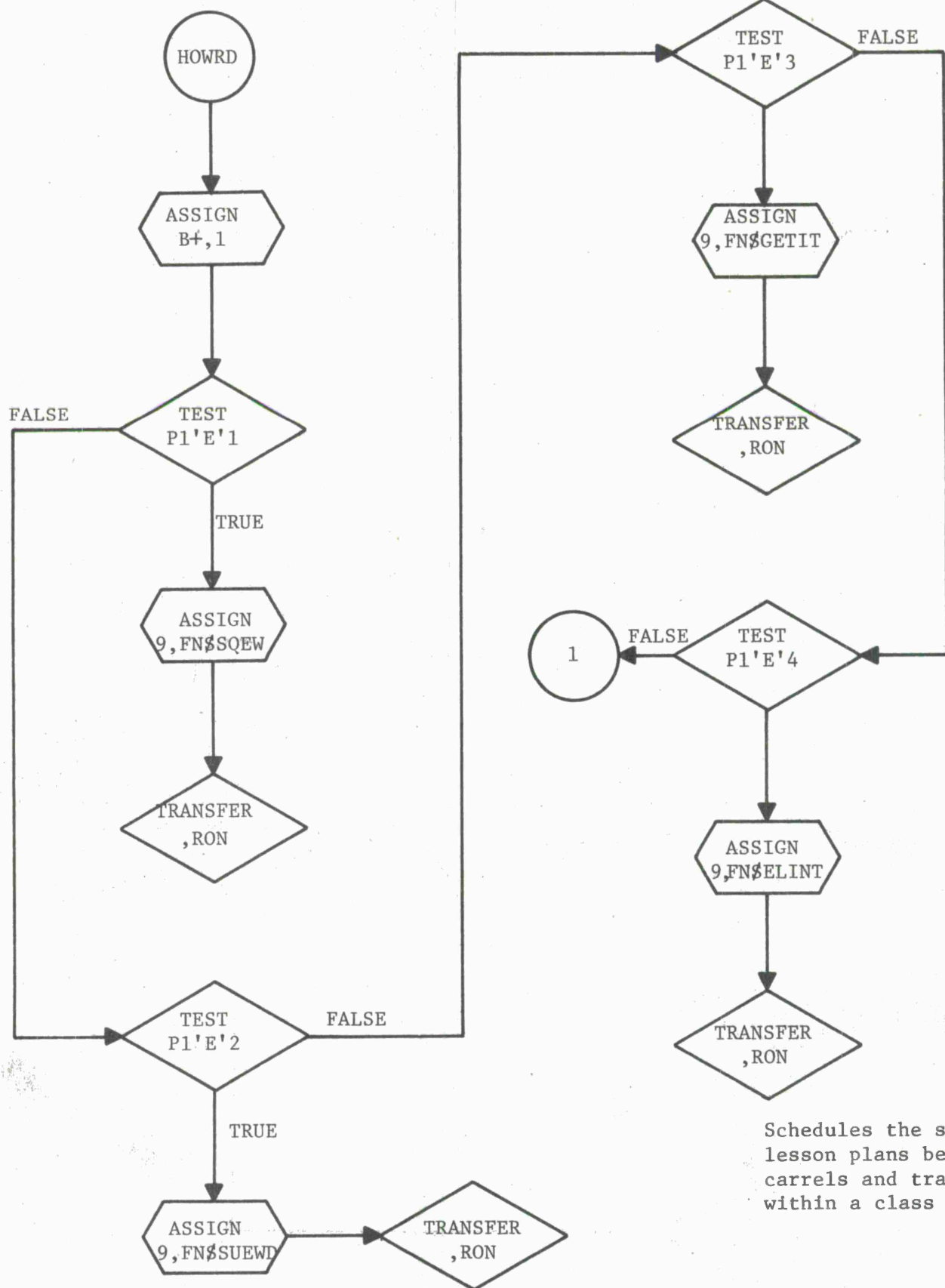


Assign- Schedules students within the first nine modules

ASIGN (PART 1)

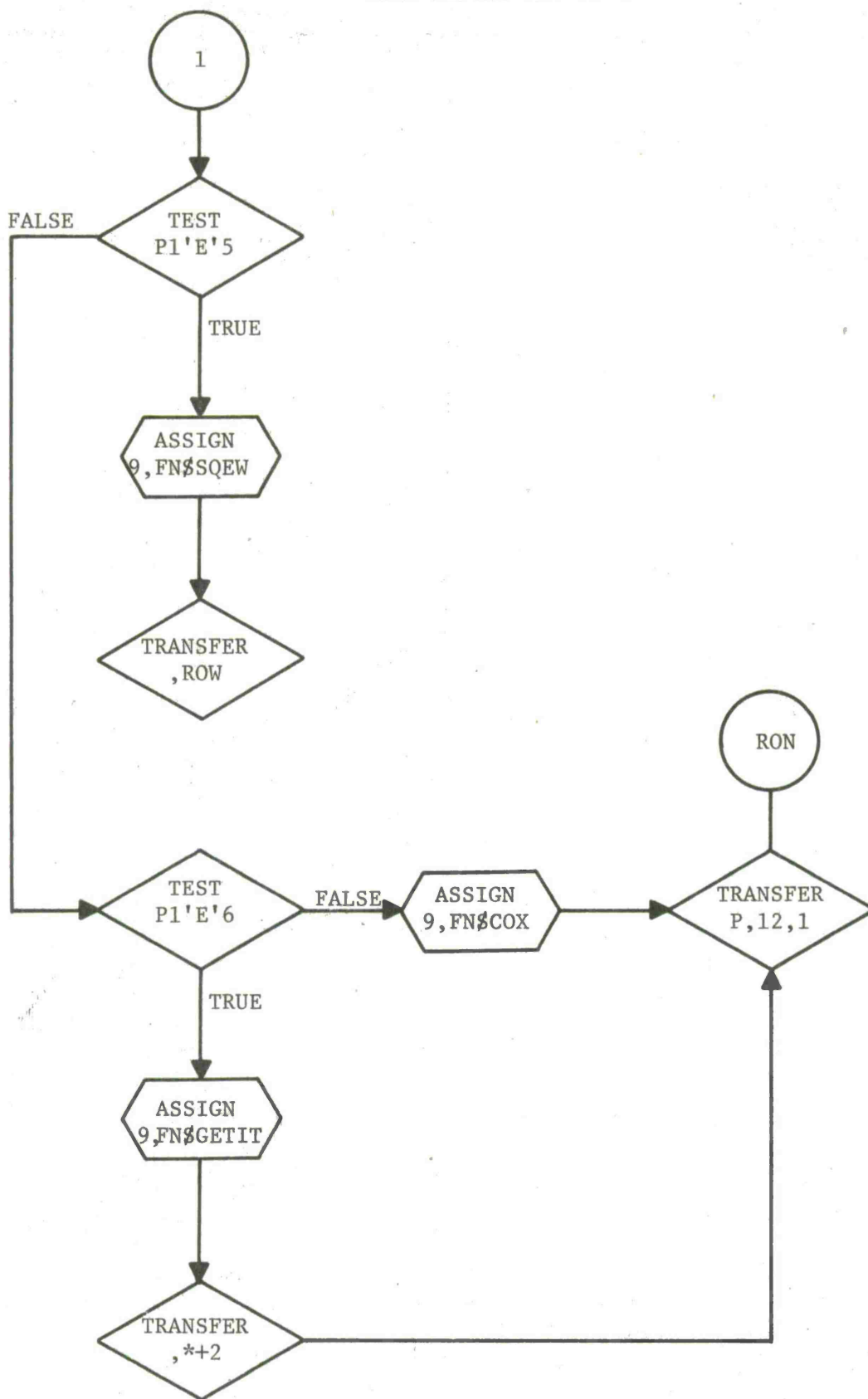


ASIGN (PART 2)



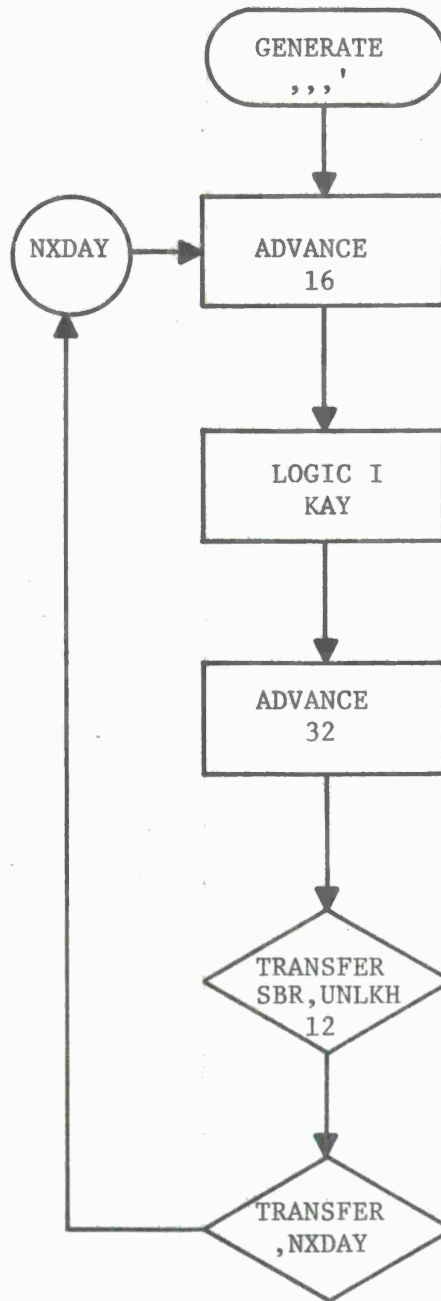
Schedules the student
lesson plans between
carrels and trainers
within a class

HOWRD

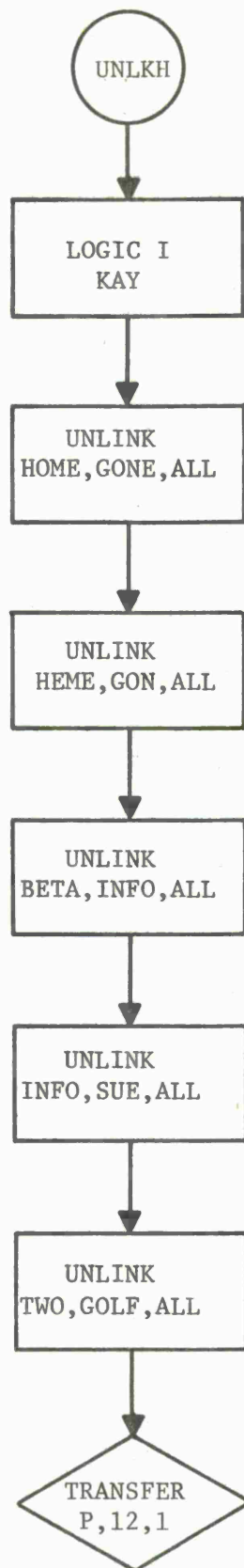


HOWRD (PART 2)

TIME-ORIENTED PROGRAMS

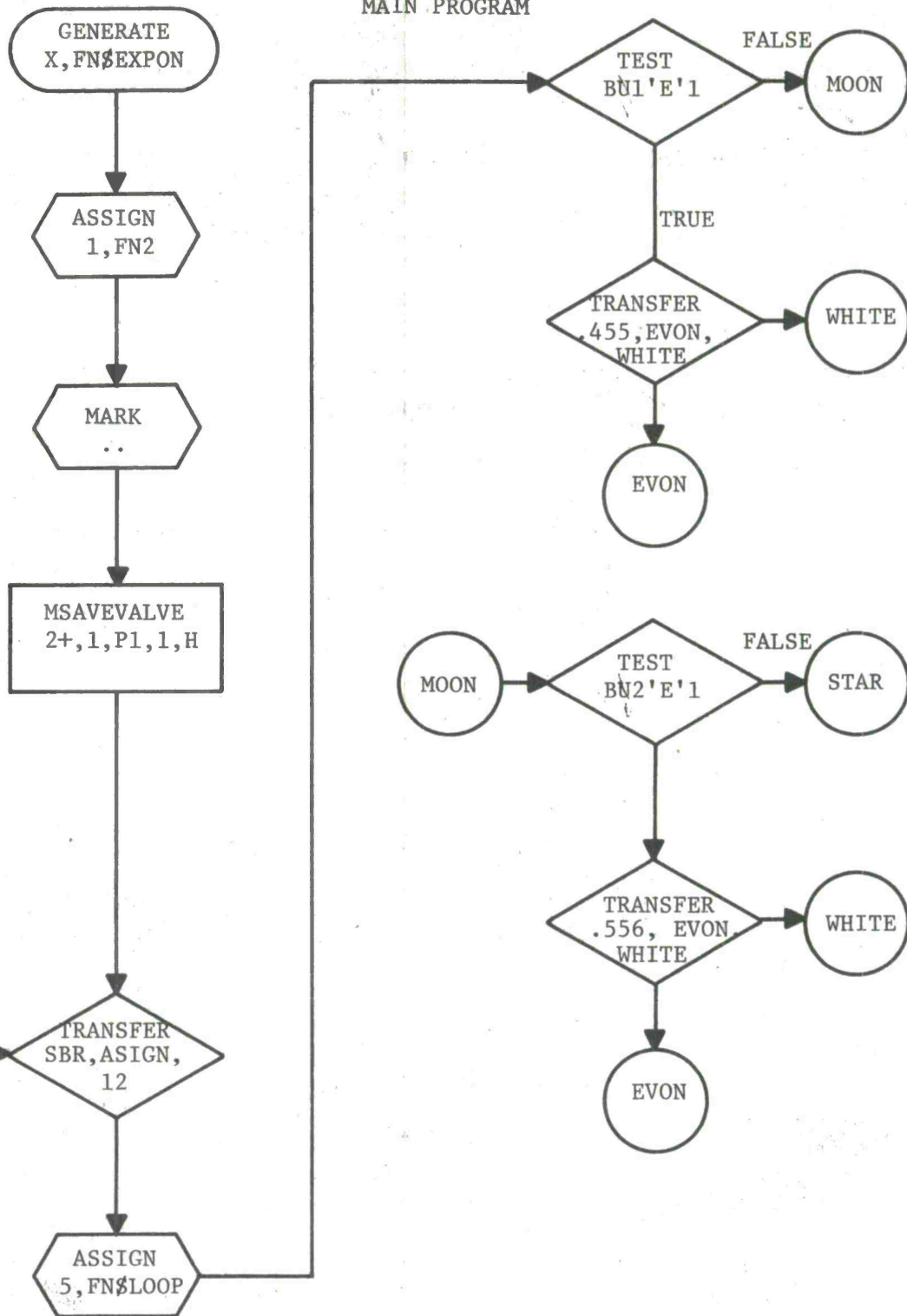


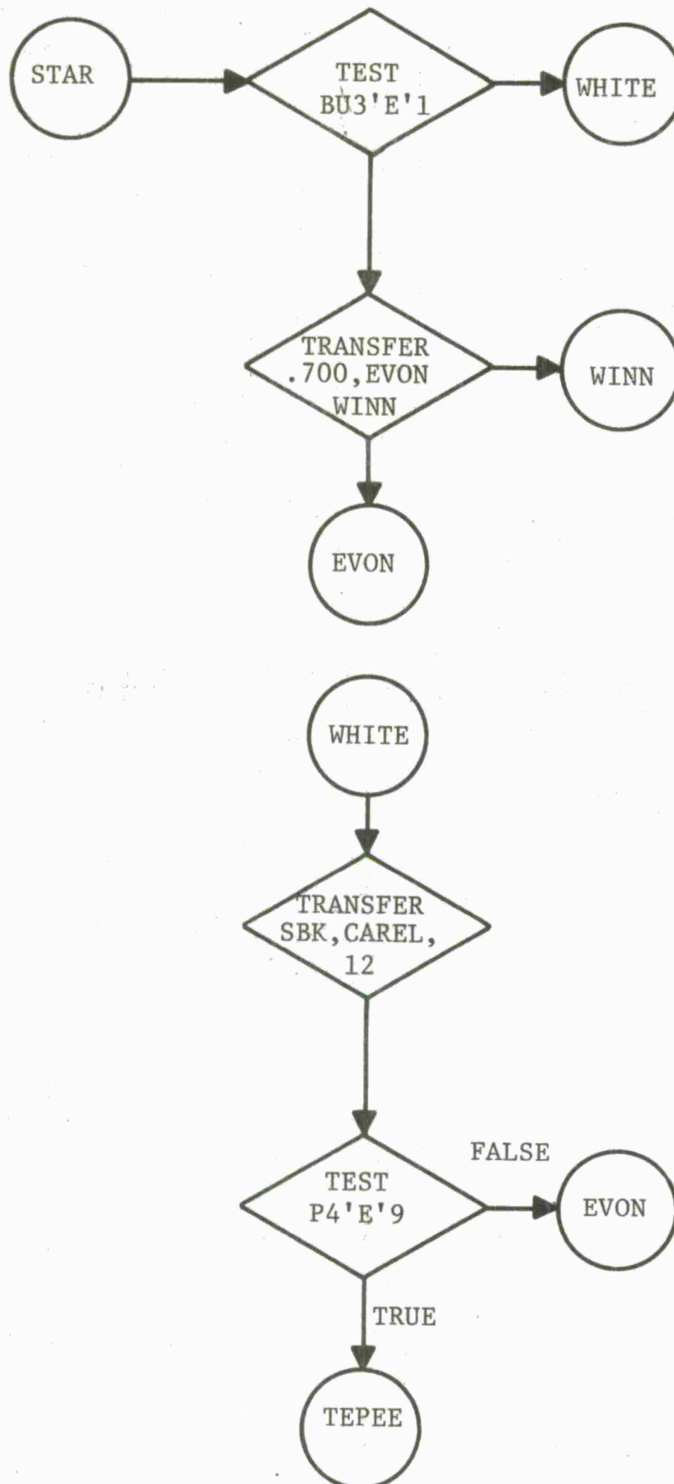
Note: Controls the number of hours for a school day, presently set at 8 hours

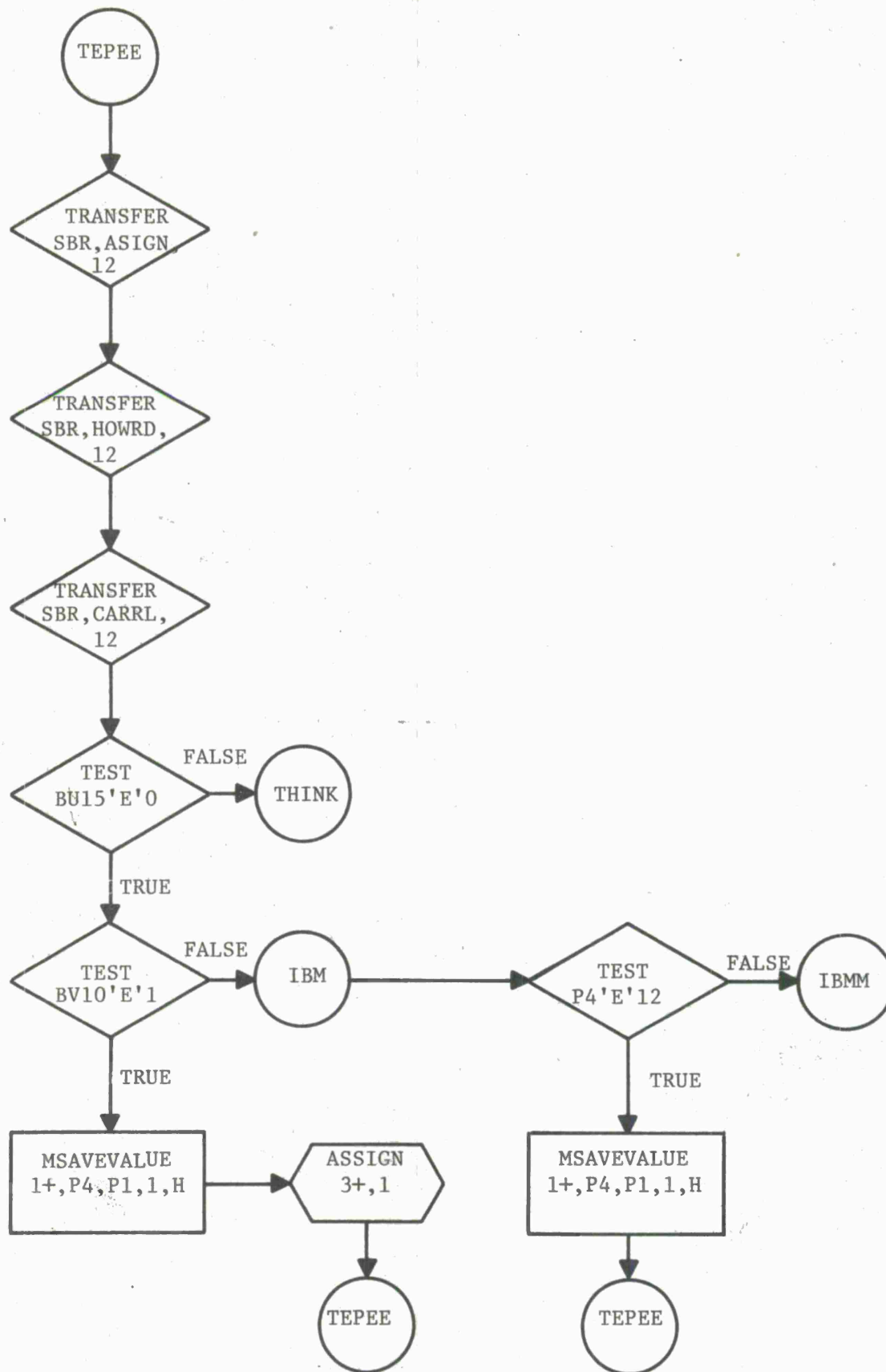


Note: Controls time in training period and number of training periods per day

MAIN PROGRAM

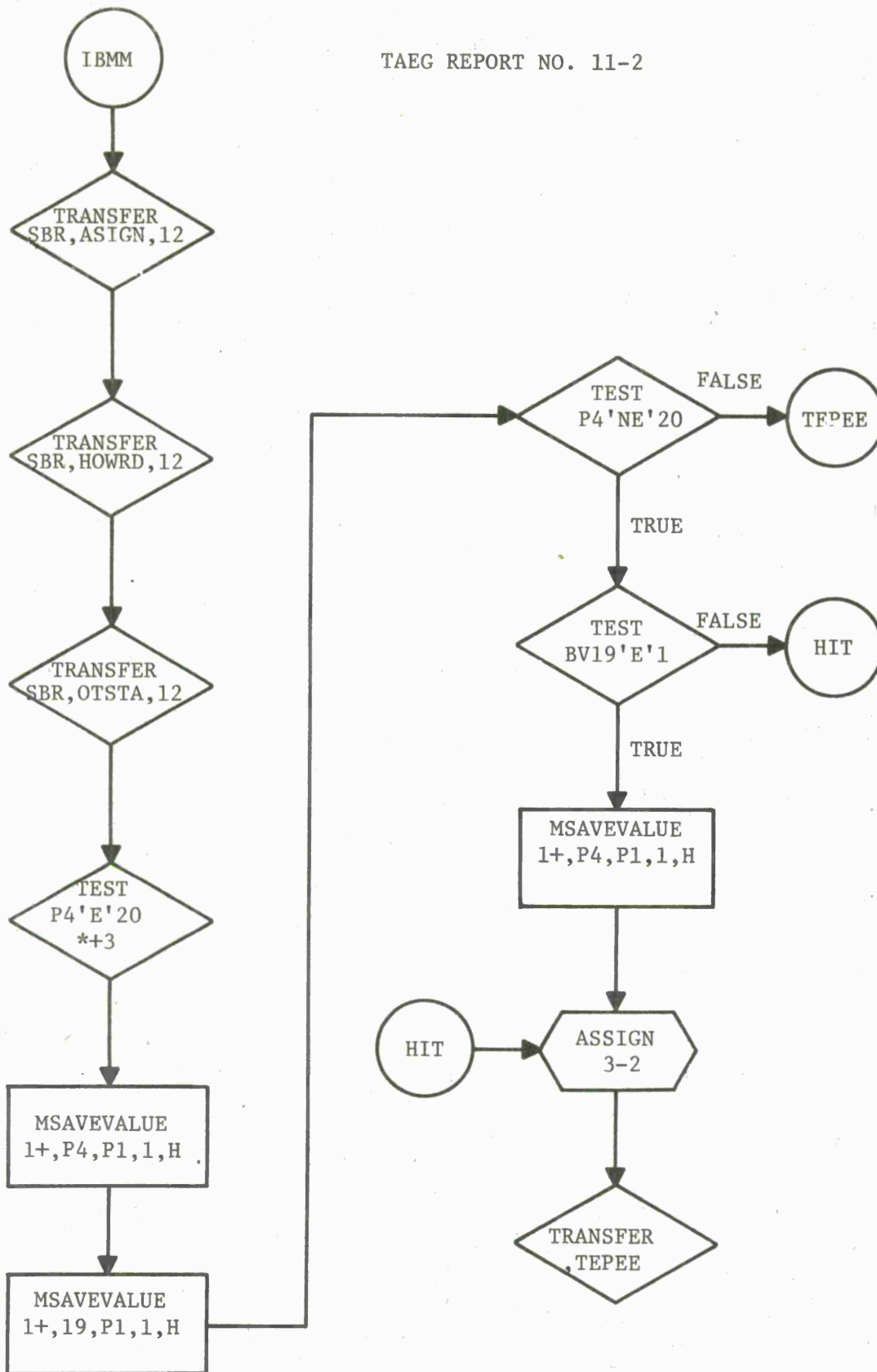


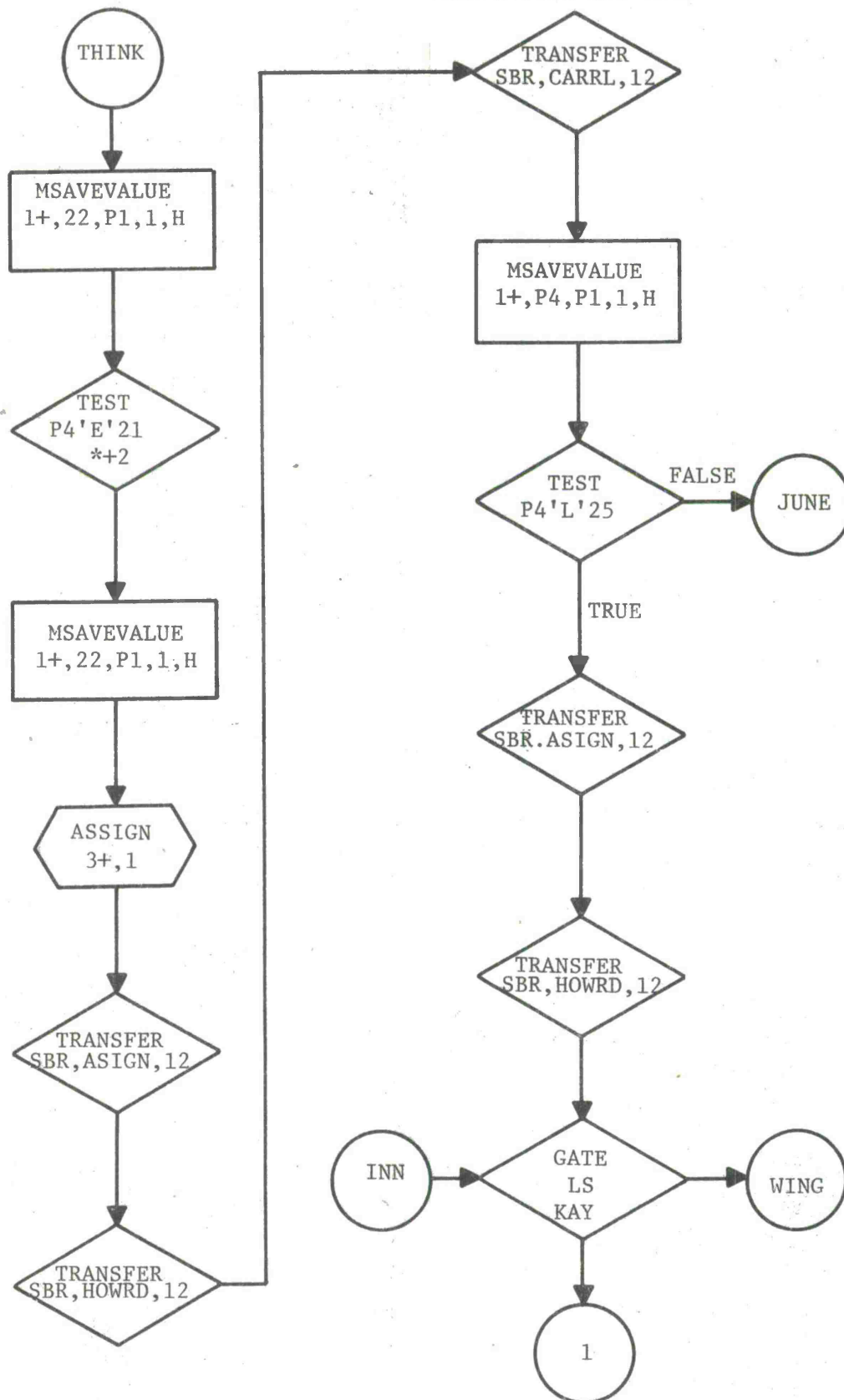


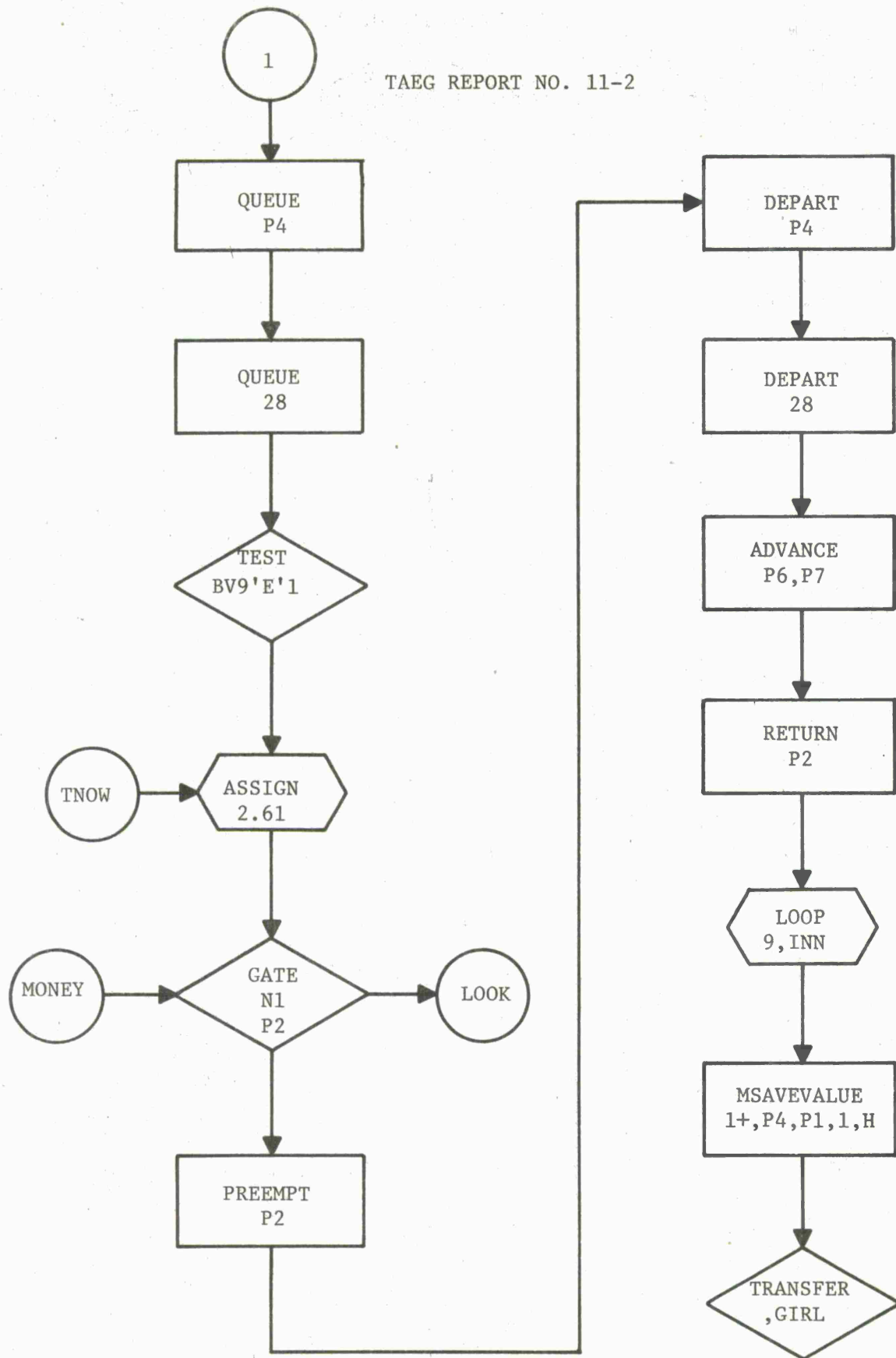


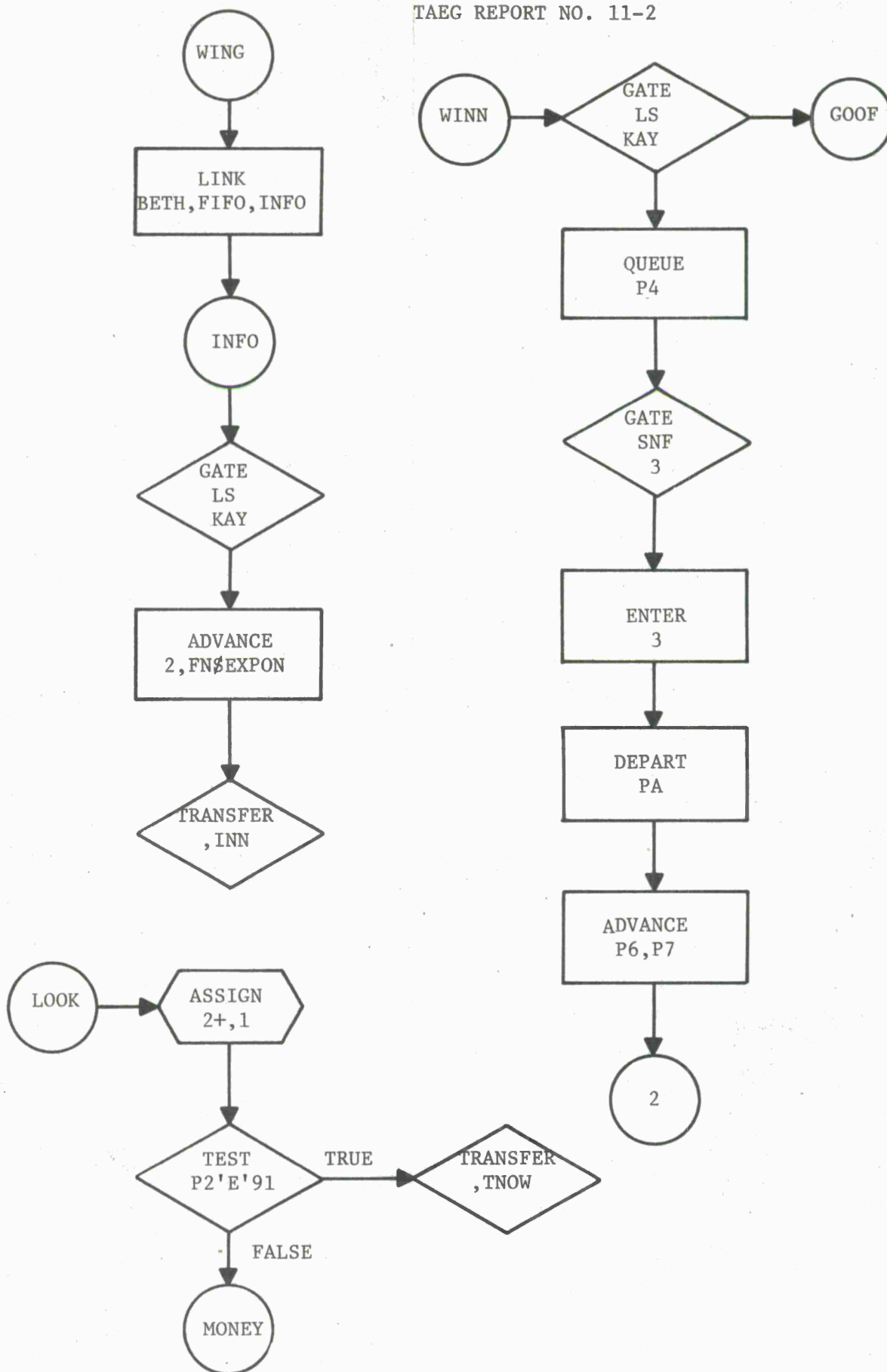
IBMM

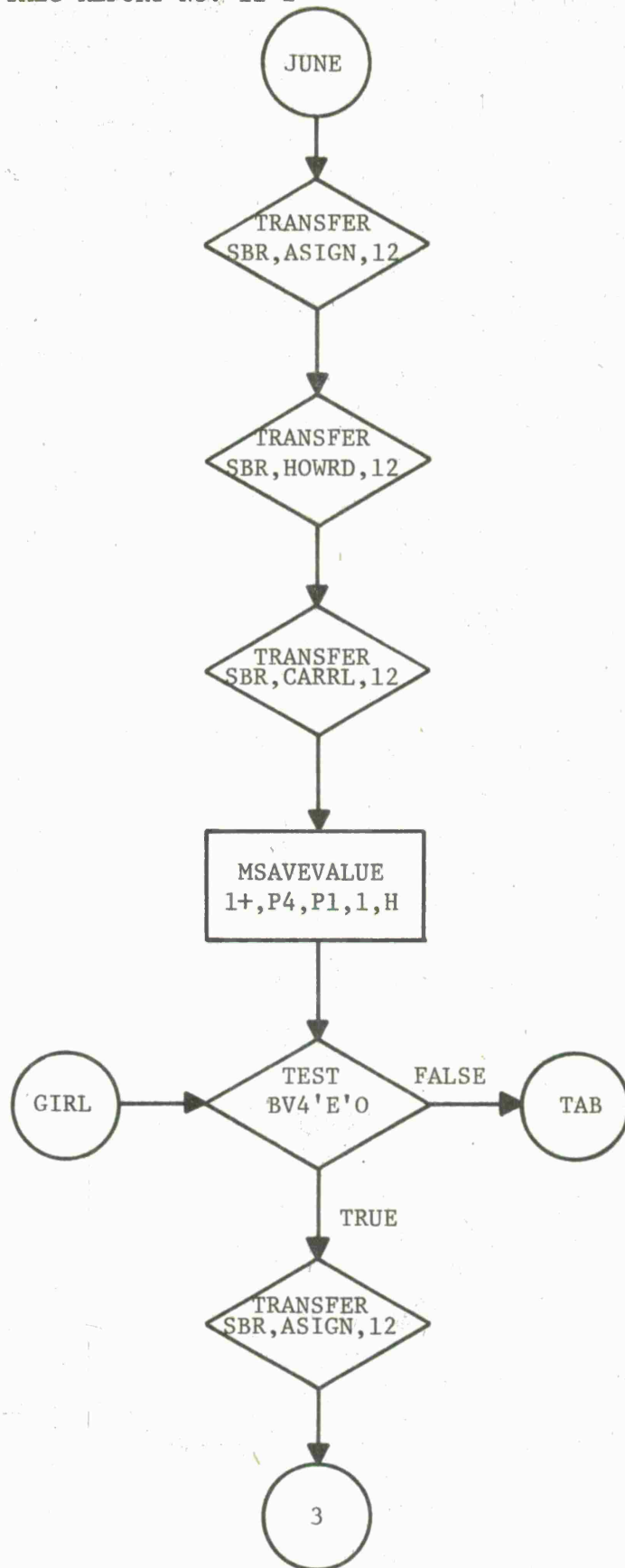
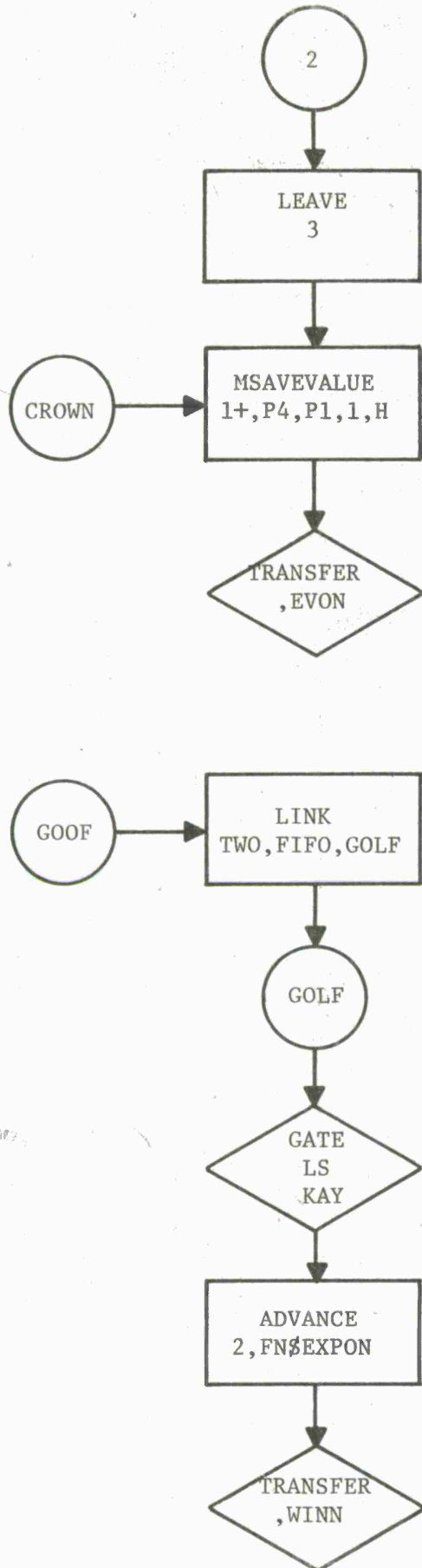
TAEK REPORT NO. 11-2

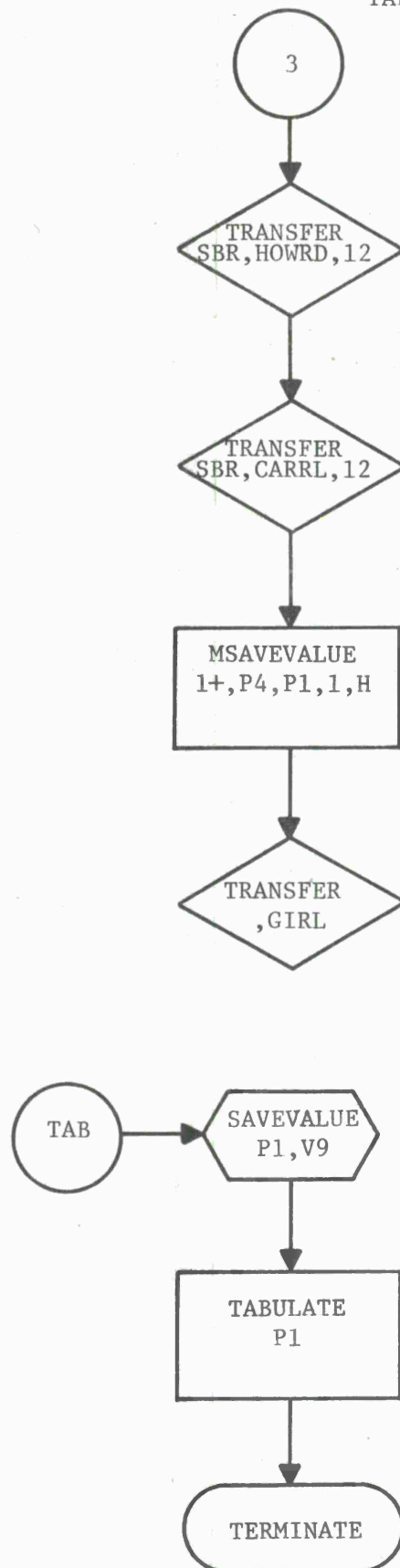












APPENDIX C

SAMPLE OUTPUT

INPUT RATE 6 STUDENTS/DAY

TAEG REPORT NO. 11-2

FACILITY	NUMBER ENTRIES	AVERAGE TIME/TRAN	-AVERAGE TOTAL TIME	UTILIZATION DURING- AVAIL. UNAVAIL. TIME TIME	CURRENT STATUS	PERCENT AVAILABILITY	TRANSACTION NUMBER SEIZING PREEMPTING
1	224	6.339	.283			100.0	232
2	226	6.000	.270			100.0	107
3	212	6.202	.262			100.0	288
4	225	5.844	.262			100.0	237
5	208	5.918	.245			100.0	67
6	205	5.975	.244			100.0	291
7	211	5.890	.248			100.0	
8	216	5.912	.254			100.0	85
9	199	5.989	.238			100.0	
10	206	5.645	.232			100.0	86
11	207	5.816	.240			100.0	102
12	201	6.039	.242			100.0	
13	202	5.836	.235			100.0	246
14	205	5.736	.234			100.0	229
15	201	6.004	.241			100.0	
16	196	5.882	.230			100.0	115
17	195	6.071	.236			100.0	157
18	204	5.691	.231			100.0	174
19	199	6.035	.239			100.0	220
20	185	6.113	.225			100.0	207
21	192	5.776	.221			100.0	182
22	189	5.830	.220			100.0	285
23	190	6.063	.230			100.0	24
24	190	5.915	.224			100.0	163
25	191	5.842	.222			100.0	139
26	186	5.881	.218			100.0	150
27	183	5.956	.217			100.0	
28	181	6.348	.229			100.0	42
29	184	5.668	.208			100.0	87
30	183	5.972	.218			100.0	131
31	182	5.846	.212			100.0	99
32	191	5.900	.225			100.0	93
33	184	5.929	.217			100.0	22
34	187	6.155	.229			100.0	178
35	187	5.898	.220			100.0	281
36	174	5.965	.207			100.0	
37	179	5.787	.206			100.0	68
38	170	6.594	.223			100.0	226
39	180	6.038	.217			100.0	
40	171	6.374	.217			100.0	284
41	166	6.433	.213			100.0	204
42	179	6.312	.225			100.0	236
43	178	6.264	.222			100.0	196
44	180	6.061	.217			100.0	64
45	170	6.205	.210			100.0	239
46	165	6.042	.199			100.0	141
47	167	5.892	.196			100.0	179
48	163	5.981	.194			100.0	156
49	163	6.368	.207			100.0	46
50	172	5.982	.205			100.0	
51	165	5.830	.192			100.0	305

[illegible]

STORAGE	CAPACITY	AVERAGE CONTENTS	ENTRIES	AVERAGE TIME/UNIT	-AVERAGE TOTAL TIME	UTILIZATION DURING- TOTAL AVAIL. TIME	CURRENT STATUS	PERCENT AVAILABILITY	CURRENT CONTENTS	MAXIMUM CONTENTS
1	220	56.066	77401	3.627	.254			100.0	220	220
2	90	18.627	15586	5.985	.206			100.0	72	90
3	50	1.196	356	16.834	.023			100.0	5	7

TAEC REPORT NO. 11-2

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QUEUES

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QUEUE	MAXIMUM CONTENTS	AVERAGE CONTENTS	TOTAL ENTRIES	ZERO ENTRIES	PERCENT ZEROS	AVERAGE TIME/TRANS	\$AVERAGE TIME/TRANS	TABLE NUMBER	CURRENT CONTENTS
1	1	.002	283	278	98.2	.038	2.199		
2	3	.003	6989	6979	99.8	.002	1.599		
3	4	.003	9742	9729	99.8	.001	1.307		
4	3	.000	5195	5193	99.9	.000	1.500		
5	1	.000	356	356	100.0	.000	.000		
6	2	.000	2408	2405	99.8	.002	1.666		
7	2	.000	1789	1789	99.9	.000	1.000		
8	2	.001	9358	9353	99.9	.000	1.399		
9	5	.002	7458	7448	99.8	.001	1.199		
10	21	.108	9818	9462	96.3	.055	1.519		8
11	7	.015	5885	5827	99.0	.013	1.327		
12	2	.001	10132	10126	99.9	.000	1.166		
13	3	.001	2335	2327	99.6	.003	1.125		
14	2	.000	466	464	99.5	.004	1.000		
15	4	.006	1489	1463	98.2	.022	1.307		
16	2	.000	1472	1471	99.9	.002	3.000		
17	11	.063	4297	4087	95.1	.074	1.514		2
18	5	.003	2974	2960	99.5	.006	1.357		
19	2	.000	1353	1352	99.9	.000	1.000		
20	2	.001	1325	1320	99.6	.006	1.599		
21	7	.037	2313	2185	94.4	.081	1.476		2
22	4	.001	3464	3459	99.8	.002	2.000		
23	1	.000	96	96	100.0	.000	.000		
24	1	.000	235	235	100.0	.000	.000		
25	3	.002	836	825	98.6	.016	1.272		1
26	3	.001	1522	1515	99.5	.004	1.000		
27	37	.238	77414	76612	98.9	.015	1.486		13
28	15	.023	15821	15736	99.4	.007	1.399		

\$AVERAGE TIME/TRANS = AVERAGE TIME/TRANS EXCLUDING ZERO ENTRIES

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TABLES

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TABLE 1		MEAN ARGUMENT		STANDARD DEVIATION		SUM OF ARGUMENTS		NON-WEIGHTED	
ENTRIES IN TABLE		37.428		1.015		524.000			
UPPER LIMIT	OBSERVED FREQUENCY	PER CENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN			
30	0	.00	.0	100.0	.801	-7.314			
31	0	.00	.0	100.0	.828	-6.329			
32	0	.00	.0	100.0	.854	-5.345			
33	0	.00	.0	100.0	.881	-4.360			
34	0	.00	.0	100.0	.908	-3.375			
35	0	.00	.0	100.0	.935	-2.391			
36	3	21.42	21.4	78.5	.961	-1.406			
37	4	28.57	49.9	50.0	.988	-.421			
38	5	35.71	85.7	14.2	1.015	.562			
39	2	14.28	100.0	.0	1.041	1.547			
REMAINING FREQUENCIES ARE ALL ZERO									

REMAINING FREQUENCIES ARE ALL ZERO

TABLE 2
ENTRIES IN TABLE

UPPER LIMIT	OBSERVED FREQUENCY	MEAN ARGUMENT 36.590	STANDARD DEVIATION 1.097		SUM OF ARGUMENTS 805.000	NON-WEIGHTED
			CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
30	0		.00	100.0	.819	-6.004
31	0		.00	100.0	.847	-5.093
32	0		.00	100.0	.874	-4.182
33	0		.00	100.0	.901	-3.271
34	0		.00	100.0	.929	-2.360
35	4	18.18	18.1	81.8	.956	-1.449
36	6	27.27	45.4	54.5	.983	-.538
37	8	36.36	81.8	18.1	1.011	.372
38	3	13.63	95.4	4.5	1.038	1.283
39	1	4.54	100.0	.0	1.065	2.194

REMAINING FREQUENCIES ARE ALL ZERO

TABLE 3
ENTRIES IN TABLE

ENTRIES IN TABLE			MEAN ARGUMENT 49.166	STANDARD DEVIATION 3.652	SUM OF ARGUMENTS .295.000	NON-WEIGHTED
UPPER LIMIT	OBSERVED FREQUENCY	PER CENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
30	0	.00	.0	100.0	.610	-5.247
31	0	.00	.0	100.0	.630	-4.973
32	0	.00	.0	100.0	.650	-4.700
33	0	.00	.0	100.0	.671	-4.426
34	0	.00	.0	100.0	.691	-4.152
35	0	.00	.0	100.0	.711	-3.878
36	0	.00	.0	100.0	.732	-3.604
37	0	.00	.0	100.0	.752	-3.331
38	0	.00	.0	100.0	.772	-3.057
39	0	.00	.0	100.0	.793	-2.783
40	0	.00	.0	100.0	.813	-2.509
41	0	.00	.0	100.0	.833	-2.236
42	0	.00	.0	100.0	.854	-1.962
43	0	.00	.0	100.0	.874	-1.688
44	0	.00	.0	100.0	.894	-1.414
45	1	16.66	16.6	83.3	.915	-1.140
46	1	16.66	33.3	66.6	.935	-.867
47	1	16.66	49.9	50.0	.955	-.593
48	0	.00	49.9	50.0	.976	-.319
49	0	.00	49.9	50.0	.996	-.045
50	0	.00	49.9	50.0	1.016	.228
51	1	16.66	66.6	33.3	1.037	.501
52	1	16.66	83.3	16.6	1.057	.775
53	0	.00	83.3	16.6	1.077	1.049
54	1	16.66	100.0	.0	1.098	1.323
REMAINING FREQUENCIES ARE ALL ZERO						

REMAINING FREQUENCIES ARE ALL ZERO

TABLE 4
ENTRIES IN TABLE

UPPER LIMIT	OBSERVED FREQUENCY	MEAN ARGUMENT 44.000	PER CENT OF TOTAL	STANDARD DEVIATION 3.613		SUM OF ARGUMENTS 704.000	NON-WEIGHTED
				CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER		
30	0		.00	.0	100.0		DEVIATION FROM MEAN
31	0		.00	.0	100.0	.681	-3.874
32	0		.00	.0	100.0	.704	-3.597
33	0		.00	.0	100.0	.727	-3.321
34	0		.00	.0	100.0	.750	-3.044
35	0		.00	.0	100.0	.772	-2.767
36	0		.00	.0	100.0	.795	-2.490
37	0		.00	.0	100.0	.818	-2.214
38	0		.00	.0	100.0	.840	-1.937
39	0		.00	.0	100.0	.863	-1.660
40	3	18.75	18.75	18.7	81.2	.886	-1.383
41	1	6.25	6.25	25.0	75.0	.909	-1.107
42	4	25.00	25.00	50.0	50.0	.931	-.830
43	1	6.25	6.25	56.2	43.7	.954	-.553
44	1	6.25	6.25	62.5	37.5	.977	-.276
45	1	6.25	6.25	68.7	31.2	1.000	-.000
46	0	.00	.00	68.7	31.2	1.022	.276
47	1	6.25	6.25	75.0	25.0	1.045	.553
48	3	18.75	18.75	93.7	6.2	1.068	.830
49	0	.00	.00	93.7	6.2	1.090	1.107
50	0	.00	.00	93.7	6.2	1.113	1.383
51	0	.00	.00	93.7	6.2	1.136	1.660
52	1	6.25	6.25	100.0	.0	1.159	1.937
REMAINING FREQUENCIES ARE ALL ZERO							2.214

TABLE 5
ENTRIES IN TABLE

UPPER LIMIT	OBSERVED FREQUENCY	MEAN ARGUMENT 53.375	STANDARD DEVIATION 1.921	SUM OF ARGUMENTS 427.000	NON-WEIGHTED
					DEVIATION FROM MEAN
30	0	PER CENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN
31	0	.00	.0	100.0	.562
32	0	.00	.0	100.0	.580
33	0	.00	.0	100.0	.599
34	0	.00	.0	100.0	.618
35	0	.00	.0	100.0	.637
36	0	.00	.0	100.0	.655
37	0	.00	.0	100.0	.674
38	0	.00	.0	100.0	.693
39	0	.00	.0	100.0	.711
40	0	.00	.0	100.0	.730
41	0	.00	.0	100.0	.749
42	0	.00	.0	100.0	.768
43	0	.00	.0	100.0	.786
44	0	.00	.0	100.0	.805
45	0	.00	.0	100.0	.824
46	0	.00	.0	100.0	.843
47	0	.00	.0	100.0	.861
48	0	.00	.0	100.0	.880
49	0	.00	.0	100.0	.899
50	0	.00	.0	100.0	.918
51	1	12.50	12.5	100.0	.936
52	2	25.00	37.5	87.5	.955
53	2	25.00	62.5	62.5	.974
54	1	12.50	75.0	37.5	.992
55	1	12.50	87.5	25.0	1.011
56	0	.00	87.5	12.5	1.030
57	1	12.50	100.0	12.5	1.049
				.0	1.067

REMAINING FREQUENCIES ARE ALL ZERO

TABLE 6
ENTRIES IN TABLE

UPPER LIMIT	OBSERVED FREQUENCY	MEAN ARGUMENT 47.438	STANDARD DEVIATION 3.109		SUM OF ARGUMENTS 12429.000	NON-WEIGHTED
			CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
30	0	.00	.0	100.0	.632	-5.608
31	0	.00	.0	100.0	.653	-5.286
32	0	.00	.0	100.0	.674	-4.965
33	0	.00	.0	100.0	.695	-4.643
34	0	.00	.0	100.0	.716	-4.322
35	0	.00	.0	100.0	.737	-4.000
36	0	.00	.0	100.0	.758	-3.678
37	0	.00	.0	100.0	.779	-3.357
38	0	.00	.0	100.0	.801	-3.035
39	0	.00	.0	100.0	.822	-2.714
40	0	.00	.0	100.0	.843	-2.392
41	0	.00	.0	100.0	.864	-2.070
42	9	3.43	3.4	96.5	.885	-1.749
43	18	6.87	10.3	89.6	.906	-1.427
44	31	11.83	22.1	77.8	.927	-1.105
45	40	15.26	37.4	62.5	.948	-.784
46	20	7.63	45.0	54.9	.969	-.462
47	11	4.19	49.2	50.7	.990	-.141
48	17	6.48	55.7	44.2	1.011	.180
49	24	9.16	64.8	35.1	1.032	.502
50	36	13.74	78.6	21.3	1.053	.823
51	37	14.12	92.7	7.2	1.075	1.145
52	11	4.19	96.9	3.0	1.096	1.466
53	7	2.67	99.6	.3	1.117	1.788
54	1	.38	100.0	.0	1.138	2.110

REMAINING FREQUENCIES ARE ALL ZERO

TABLE 7
ENTRIES IN TABLE

ENTRIES IN TABLE		MEAN ARGUMENT 22.161	STANDARD DEVIATION 1.097	SUM OF ARGUMENTS 687.000	NON-WEIGHTED	
UPPER LIMIT	OBSERVED FREQUENCY	PER CENT OF TOTAL	CUMULATIVE PERCENTAGE	CUMULATIVE REMAINDER	MULTIPLE OF MEAN	DEVIATION FROM MEAN
20	1	3.22	3.2	96.7	.902	-1.968
21	9	29.03	32.2	67.7	.947	-1.057
22	8	25.80	58.0	41.9	.992	-.146
23	11	35.48	93.5	6.4	1.037	.764
24	1	3.22	96.7	3.2	1.082	1.675
25	1	3.22	100.0	.0	1.128	2.586
REMAINING FREQUENCIES ARE ALL ZERO						

REMAINING FREQUENCIES ARE ALL ZERO

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HALFWORD MATRICES

HALFWORD MATRIX 1

ROW/COLUMN	1	2	3	4	5	6	7
1	0	0	4	14	21	244	0
2	0	0	7	11	20	267	0
3	0	29	14	22	19	479	0
4	20	29	14	22	19	466	0
5	0	0	7	0	17	327	0
6	20	28	13	22	19	458	38
7	20	28	13	22	18	454	38
8	20	0	12	22	18	443	0
9	18	28	12	21	18	426	37
10	17	26	11	19	14	368	0
11	17	26	11	19	14	370	0
12	17	26	11	18	14	350	37
13	17	24	9	17	14	336	37
14	17	24	9	17	14	338	37
15	0	0	9	17	12	326	0
16	0	0	9	17	12	326	0
17	16	23	8	16	12	304	34
18	16	23	8	16	12	307	34
19	16	0	7	0	11	292	0
20	16	0	7	0	11	292	0
21	15	22	7	16	10	269	31
22	15	22	7	16	10	269	31
23	0	0	7	0	9	0	31
24	0	0	7	0	9	0	31
25	15	22	6	16	9	266	31
26	14	22	6	16	8	262	0

ROWS 27-28, COLUMNS 1-7 ARE ZERO